UPPER GREAT LAKES CONNECTING CHANNELS INTERLABORATORY PERFORMANCE EVALUATION STUDY INTEGRATED REPORT PART I: ORGANIC PARAMETERS

by
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1.0 INTRODUCTION

The Upper Great Lakes Connecting Channels Study (UGLCCS) was established to identify and deal with the environmental problems involved with the St. Mary's, St. Clair and Detroit Rivers and Lake St. Clair. A three year, binational study was started in 1984, involving Canadian and U.S. environmental and resource agencies.

The UGLCC study recognizes Quality Assurance/Quality Control (QA/QC) aspects as crucial elements to the overall utility of study results. The Quality management Work Group was formed, in part, thirteen interlaboratory performance evaluation (QC) studies were designed and conducted to assist analytical laboratories, which were producing data for the UGLCC study to generate reliable, accurate data and to assess their overall performance during this study.

Thirteen individual final reports on these interlaboratory studies have been completed, as listed in Appendix I. To further assist the project leaders, managers and users of data to comment on the comparability of data generated by their participating laboratories, two integrated reports, one for organic and other for inorganic parameters, respectively are generated. These reports summarize and evaluate these interlaboratory studies. In this report, the organic parameters including organochlorine pesticides (OCs), PCBs, chlorinated hydrocarbons (CHs) and polychlor aromatic hydrocarbons (PAHs) are integrated for these interlaboratory results.

2.0 STUDY DESIGN

To support the Upper Great Lakes Connecting Channels Study, the Quality Management Work Group (QMWG) has been formed, in part, to design and conduct interlaboratory performance evaluation (QC) studies. Since the most serious sources of variation between results from different laboratories was control of standards and calibration process (1), the QMWG agreed to place most emphasis on the

distribution of a series of check standards covering all of the UGLCCS parameters for which check standards were available.

The samples for these interlaboratory studies and the constituents for which analyses were requested involved 36 inorganic and 50 organic parameters ~~and~~ are listed in Table 2.1.

The participants in these studies from different governmental and private laboratories in Canada and the U.S. are tabulated in Table 2.2 .

The schedule of these QC studies are listed in Table 2.3.

Each study consisted of four to eight samples which contained either standard solutions in ampules, surrogate spikes for waters and a limited number of natural reference materials. All studies were prepared to address a sequence of test samples that covered a constituent concentration range of one or two orders of magnitude. In order to evaluate the within-lab precision of these studies, most samples were sent out with blind duplicates. All samples were well-characterized with their stability verified in advance. This stability was essential for these studies and was further verified by re-using the identical samples in various studies. Thie approach has been successfully used in IJC and LOTAP interlaboratory studies (1,2).

All studies were prepared and distributed from the Research and Applications Branch at National Water Research Institute in Burlington.

3.0 DATA EVALUATION

In this report for organic parameters, because of the small number of results available for these studies, the Youden ranking technique for the detection of bias, as well as the computerized flagging procedure were not used for data evaluation. Instead, the percent recoveries for each result based on the design values were calculated. The individual results from participating laboratories were evaluated as very high, high, satisfactory, low or very low as follows:

Percent Recovery	Designation (Flags)
≥ 150	Very high
149 - 125	High
124 - 76	Satisfactory
75 - 51	Low
≤ 50	Very low

In addition to flags as described above, bias were evaluated not for a single individual result but for each parameter provided on the series of test samples. In this case, average recoveries of test samples for each parameter were calculated. Similarly, the bias for each parameter from participating laboratories were evaluated as very high, high, satisfactory, low or very low as follows:

Percent Average Recovery	Designation (Bias)
≥ 150	Very high
149 - 125	High
124 - 76	Satisfactory
75 - 51	Low
≤ 50	Very low

See Appendix II for a summary of each laboratory's appraisal for flags and bias in various studies.

In these laboratory comparison studies, medians rather than means preferred for evaluating accuracy of interlaboratory results where there were relatively few data and the means were strongly influenced by outliers. For evaluating precision of interlaboratory results, means and standard deviations were calculated with outliers removed by using Grubb's test (3). The standard deviation (σ) and percent RSD were calculated as follows:

$$\sigma = \sqrt{\Sigma(x_i - \bar{x})^2/n-1}$$

where x = individual result, $\bar{x}$ = mean,

and n = number of individual results

and % RSD = $\sigma/\bar{x} \times 100$

where $\bar{x}$ = mean

4.0 RESULTS AND DISCUSSION

In this integrated report, the results for organic parameters are discussed in the following groups of parameters:

1) OCs: QM-1 and QM-8
2) PCBs: QM-1 and QM-7
3) CHs: QM-1, QM-6 and QM-7
4) PAHs: QM-2 and QM-10

The chlorophenols and total phenols were conducted only in one study as QM-13 and QM-12, respectively. These results are not integrated in this report. See the individual final reports for their evaluation.

In this report, the interlaboratory comparability for accuracy and precision, and comparison of laboratory performance in various studies are discussed.

4.1 Interlaboratory Comparability

Interlaboratory Performance Evaluation (QC) studies were used to determine if differences existed between analytical results of participating laboratories and to estimate analytical precision of participating laboratories. See Appendix III for a summary of within-lab precision in various studies.

4.1.1 QC parameters:

QCs were conducted in UGLCCS:QM-1 (January 24, 1986) and QM-8 (March 27, 1986) interlaboratory studies. The participants for these studies are given in Table 4.1.1.

QM-1 was analyzed for ampules only and QM-8 was analyzed for ampules and spiked waters.

Interlaboratory studies of QCs in QM-1 and QM-8 have included test samples in ampules which were identical samples for the demonstration of stability of sample constituents and further verification of the design values. Samples 105/108 in QM-1 and samples 801/802 in QM-8 were one group of identical samples with a mixture of 7 QC parameters. Samples 106/107 in QM-1 and samples 803/804 in QM-8 were ~~also~~ other group of identical samples with a mixture of 5 QC parameters. Summaries of the design values and interlaboratory medians for these two groups of identical samples are given in Tables 4.1.2a and 4.1.2b. Figures 4.1.1a and 4.1.1b show the percent recoveries of interlaboratory medians for QC parameters in these two groups of identical samples. In UGLCC interlaboratory studies, QMWG had set results within ±25% of the design values for organic parameters as satisfactory. As can be seen from the above figures, the agreement of interlaboratory medians in these identical samples was excellent. In addition, the results for all these samples were satisfactory within ±25% of the design values for all QC parameters except sample 108 in QM-1 was different by more than 25% of design value for p,p'-DDD.

In order to detect the bias of interlaboratory results, the range and average of interlaboratory medians for all QC parameters in various studies are summarized in Table 4.1.3. Figure 4.1.2 presents condensed results of average recoveries of interlaboratory medians results for all samples in various studies. As can be seen from this figure, the interlahoratory results were comparable and satisfactory for all QC parameters in ampules of both QM-1 and QM-8. Furthermore, the interlaboratory results in QM-8 were more accurate than those in QM-1 for all QC parameters in most cases.

As may be expected, the percent average recoveries of OCs in spiked water samples in QM-8 were less accurate as compared with ampule samples in both QM-1 and QM-8 studies. However, the interlaboratory results for all OCs in QM-8 were still satisfactory within +25% of design values except HCB was different by more than 25% of design value.

Precision of interlaboratory results for OCs in various studies is summarized in Table 4.14. Figure 4.1.3 shows average RSDs for all OC parameters graphically in various studies. As can be seen from this figure, average RSDs for all OCs in both ampules of QM-1 and QM-8 were satisfactory with ≤25% in most cases, except HCB in QM-1 and QM-8 and p,p'-DDD in QM-8 were more than 25%. Precision of spiked water samples in QM-8 was worse than ampule samples. Nine out of 12 OCs were more than ±25% average RSDs, and only three parameters (dieldrin, α-chlordane and γ-chlordane) were less than ±25% average RSDs.

4.1.2 PCBs

PCBs were conducted in UGLCCS: QM-1 (January 24, 1986) and QM-7 (March 27, 1986) interlaboratory studies. The participants for these studies are given in Table 4.1.5.

QM-1 was analyzed for ampules only and QM-7 was analyzed for ampules and spiked waters.

Interlaboratory studies of PCBs in QM-1 and QM-7 have included test samples in ampules which were identical samples for the demonstration of traceability. Samples 102/104 in QM01 and samples 701/702 in QM-7 were identical samples. A summary of design value and interlaboratory medians for PCBs in these identical samples is given in Table 4.1.6. Figure 4.1.4 presents the percent recoveries of interlaboratory medians for PCBs in these test samples. The agreement of interlaboratory medians in these samples was excellent and percent recoveries of interlabortory results were all satisfactory within ±25%

of the design values in both studies. Thus the design values of these ampules were further verified.

The range and average of percent recoveries of interlaboratory medians for PCBs in various studies are summarized in Table 4.1.7. Figure 4.1.5 presents graphically the range and average of recoveries of interlaboratory medians for PCBs among samples in various studies. Although analysis of PCBs was complicated, the interlaboratory results showed that PCBs was one of the organic parameters conducted by UGLCCS interlaboratory studies for which less scattered results were obtained by participating laboratories. As can be seen from this figure, the interlaboratory results for ampules were comparable and satisfactory with percent average recoveries within ±10% of design values in both QM-1 and QM-7 studies. For the spiked waters in QM-7, the interlaboratory results were less accurate than those obtained in ampules, but the results were still satisfactory with recoveries within ±25% of the design values. Overall, the accuracy of interlaboraory comparability for PCBs in ampules and spiked waters was very satisfactory in both studies.

Precision of interlaboratory results for PCBs in various studies is summarized in Table 4.1.8. Figure 4.1.6 presents graphically the range and average of RSDs for PCBs among samples in various studies. As expected, average RSDs were better than ±25% for ampules in both QM-1 and QM-7 studies, but it was more than ±25% for spiked water in QM-7.

4.1.3 CH parameters

CHs were conducted in UGLCCS: QM-1 (January 24, 1986), QM-6 (February 28, 1986) and QM-7 (March 27, 1986) interlaboratory studies. The participants for these studies are given in Table 4.1.9.

QM-1 was analyzed for ampules only with samples at two concentrtion levels; QM-6 was analyzed for ampules and sediments in which two ampule samples at two concentration levels and sediment samples with various natural contaminant concentrations and QM-7 was

analyzed for ampules and spiked waters with different concentration levels.

Interlaboratory studies of CHs in QM-1, QM-6 and QM-7, as those for OCs and PCBs, have included test samples which were identical samples for the demonstration of stability and traceability. Samples 110/111 in QM-1, sample 607 in QM-6 and samples 703/704 in QM-7 were one group of the identical samples. While samples 109/112 in QM-1 and sample 605 in QM-6 were the other group of identical samples. Summaries of the design values and interlaboratory medians in these identical samples are given in Table 4.1.10a and 4.1.10b. Figures 4.1.9a and 4.1.9b present the percent recoveries of interlaboratory medians for all CHs in these identical samples. A similar pattern of consistency in regarding interlaboratory medians for all CHs as that obtained for OC and PCBs was demonstrated. These results suggest that the interlaboratory performance by participating laboratories have improved in QM-6 and QM-7 as compared with that in QM-1 in most cases. As can be seen from Figure 4.1.9a, two parameters (1,3,5-TCB and 1,2,4,5-TeCB) in sample 110 and three parameters (1,3,5-TCB, 1,2,4,5-TeCB and 1,2,3,4-TeCB) in sample 111 of QM-1 were different by more than 25% of the design values; while all CHs were satisfactory within ±25% of the design value in sample 606 of QM-6 and samples 703/704 of QM-7. Similarly, as can be seen from Figure 4.1.6b, four parameters (1,3,5-TCB, 1,2,3-TCB, 1,2,4,5-TeCB and 1,2,3,4-TeCB) in sample 109 and five parameters (1,3,5-TCB, 1,2,4-TCB, 1,2,3-TCB, 1,2,4,5-TeCB, and 1,2,3,4-TeCb) in sample 112 of QM-1 were different by more than 25% of the design values; while all CH parameters were satisfactory within ±25% of the design values in sample 605 of QM-6. These results indicate that these interlaboratory studies have helped the participating laboratories to correct their internal quality control and the quality of test samples used for these evaluation was further verified.

In order to evaluate the interlaboratory comparability, the range and average of percent recoveries of interlaboratory medians in various studies are summarized in Table 4.1.11.

Condensed results of average recoveries of interlaboratory medians for all 13 CH parameters is shown in Figure 4.1.~~8~~. For the ampule samples, nine out of 13 CHs in QM-1 interlaboratory study were satisfactory within ±25% of design values, the four CH parameters (1,3,5-TCB, 1,2,3-TCB, 1,2,4,5-TeCB and 1,2,3,4-TeCB were different by more than 25% of design values, whereas all CHs in QM-6 and QM-7 were satisfactory within ±25% of design values. As expected, the interlaboratory results for spiked waters (QM-7) and sediments (QM-7) was less satisfactory as compared with the ampule samples (QM-1, QM-6 and QM-7). Overall, only six out of 13 parameters (1,4-DCB, 1,2-DCB,1,2,4,5-TeCB, PeCB, HCB and OCS) in water samples (QM-7) were satisfactory within ±25% of design values. The performance of spiked waters for CHs (QM-7) was less satisfactory as compared with those of spiked waters for OCs (QM-8) and PCBs (QM-7). However, the interlaboratory results for sediments was less satisfactory as compared with ampule samples but were better than those in spiked water. Overall, seven out of 12 CH parameters were satisfactory within ±25% of design values (HCE was not evaluated since reference value was not available). Only five parameters (1,4-DCB, 1,2-DCB, 1,3,5-TCB, 1,2,3-TCG and 1,2,3,4-TeCB) were different by more than 25% of design values. ~~Less than~~ Poor quantitative recoveries of CHs from spiked waters were not unexpected because of the volatility of most CHs, resulting in evaporative losses. In addition, the high water solubilities of some CHs also cause poor extraction recoveries.

Table 4.1.12 presents the range and average of RSD of CHs after statistical outliers were removed. Outliers were detected by Grubb's test (3). Figure 4.1.~~9~~ presents condensed results of average RSDs for all 13 CH parameters determined in various interlaboratory studies. As can be seen from this figure, for ampule samples, significantly better results were produced in QM-6 and QM-7 as compared with those in QM-1 in most cases for ~~these~~ CHs. ~~Average RSDs were ±25% or less for only six out of 13 CH parameters determined in QM-1 in most cases for these CHs~~. Average RSDs were ±25% or less for

only six out of 13 CH parameters determined in QM-1 interlaboratory study while average RSDs was ±25% or less for 11 out of 13 CHs and 9 out of 13 CHs in QM-6 and QM-7, respectively. As expected, the precision was much worse for spiked waters (QM-7) and sediments (QM-6) than those for ampules. Average RSDs were ±25% or less for only one out of 13 CHs and four out of 12 CHs in QM-7 (water) and QM-6 (sediment), respectively. While average RSDs were 50% or more for five parameters (1,4-DCB, 1,2-DCB, 1,3,5-TCB, HCB and OCs) in QM-7 (water) and only one parameter (1,4-DCB) in QM-6 (sediment).

4.1.4 PAH parameters

PAHs were conducted in UGLCC QM-2 (January 24, 1987) and QM-10 (May 1, 1986) interlaboratory studies. The participants for these studies are given in Table 4.1.13.

QM-2 was analyzed for ampules (standard solutions) only with samples 201 through 204 at two concentration levels. QM-10 was analyzed for ampules and spiked waters in which two ampule samples and spiked water samples were both at two concentration levels.

Interlaboratory studies of PAHs in QM-2 and QM-10 as for OCs, PCBs and CHs, have included test samples which were identical for the demonstration of traceability and verification of the stability and design values of the sample constituents. For these PAHs interlaboratory studies, samples 203/204 in QM-2 and sample 1002 in QM-10 were identical. A summary of the design values and interlaboratory medians for 16 PAH parameters in these identical samples conducted in QM-2 and QM-10 is given in Table 4.1.14. Figure 4.1.10 shows the percent recoveries of interlaboratory medians for all PAH parameters in these identical samples.

The agreement between these samples for PAHs conducted in QM-2 and QM-10 was excellent in most cases. Significant better results were obtained in QM-10 than in QM-2. Six out of 16 PAHs were differed by more than ±25% of design values for both samples 203/204

in QM-2 while only one out of 16 PAHs (phenanthrene) was differed by more than 25% of design values in QM-10.

For the comparison of the performances of PAHs in these interlaboratory studies in terms of accuracy for the interlaboratory comparability, the range and average of recoveries of interlaboratory medians are summarized in Table 4.1.15. Figure 4.1.8 presents graphically the condensed results of percent average recovery of interlaboratory medians for all 16 PAHs in various studies. For the ampule samples, the interlaboratory results were satisfactory within ±25% of the design values in most cases. Only three out of 16 parameters (fluroene, phencathrene and chrysene) were different by more than 25% of the design value in QM-2, while all 16 PAH parameters were satisfactory within ±25% of design values in QM-10. The performance of PAHs had significant improvement in QM-10 as compared with that in QM-2. As compared with ampule samples in QM-2 and QM-10, the percent average recoveries of interlaboratory medians in spiked waters in QM-10 were less satisfactory for all PAHs in most cases. In general, percent average recoveries of interlaboratory medians for a given parameter were lower for spiked waters than those for ampule samples. However, only four out of 16 PAHs (acenaphythene, acenaphthene, fluroene and phenanthrane) were differed by more than ±25% of the design values. For the spiked waters, the performance of interlaboratory results of PAHs was less satisfactory than those for OCs and PCBs, but these results were significant better than those for CHs in these interlaboratory studies.

The precision of interlaboratory results for PAHs in various studies were calculated with outliers removed by Grubb's test (3). The range and average of RSD for PAHs in various studies are given in Table 4.1.16. Figure 4.1.12 presents the condensed results of percent average RSD's for all 16 PAH parameters determined in various interlaboratory studies. For the ampule samples, significant better results were obtained for QM-10 as compared with QM-2. It showed that only three out of 16 PAHs (pyrene, dibenzo(a,h)anthracene and

benzo(g,h,i) perylene) were 25% or less average RSDs in QM-~~10~~ 2. For the spiked water samples, only six out of 16 PAHs were 25% or less average RSDs in QM-10. The performance of spiked water in QM-10 was less satisfactory as compared with ampule samples in QM-10, but was significant better than those ampule samples in QM-2. These results indicated that the performance of participating laboratories in QM-10 has improved extensively for most of participating laboratories.

While 11 out of 16 PAHs were better than 25% Avg. RSDs in QM-10.

4.2 Comparison of Laboratory Performance in Various Studies

The key to administration of any information on involving the laboratory performance data was the selection of acceptable criteria. The performance evaluation in this integrated report was based on the percent biased of parameters analyzed and percent flagged of results reported. For the flags, the number of results reported by each laboratory excluding those with "ND" or "NS" signs, the sum of results flagged with VH, H, L or VL for all parameters, and the percentages of results flagged were calculated. Note that H and L flags ~~are~~ were counted as half of a VH and VL flags. In addition less than values that were flagged were included in the calculation of the percent flagged. Similarly for the bias, the number of parameters analyzed by each laboratory, the sum of parameters biased with VH, H, L or VL based on average recovery for a set of samples, and percent of parameters biased ~~are~~ were calculated. Note that H and L parameters biased ~~are~~ were counted as a half of a VH or VL parameter biased.

The above criteria can be used independently in evaluating the laboratory performance of interlaboratory results. To simplify the overall assessment of laboratory performance in various studies, the average of percent biased and percent flagged ~~is~~ was calculated. This criteria provided a simple way to compare laboratory performance in various studies as shown below:

Average of Percent Biased and Percent Flagged	Comment
$\leq$ 25%	Satisfactory (A)
26 - 50%	Moderate (B)
$\geq$ 51%	Poor (C)

Results of the above-mentioned criteria obtained in various studies are summarized for OCs, PCBs, CHs and PAHs in Table 4.2.1 to 4.2.4 respectively. The detailed discussion for the relative performance of these studies are described below.

4.2.1. OCs:

For the laboratory performance for OCs in various studies as shown in Table 4.2.1, few laboratories such as U001, U014 and U072 have achieved consistency for producing satisfactory results for both ampule and spiked water samples. In addition, these laboratories analyzed all the samples provided and most parameters requested. Some other participating laboratories (U005, U009, U091 and U092) also produced satisfactory results but only participated in one study either QM-1 for ampules or QM-8 for both ampules and spiked waters. However, for these OC's interlaboratory studies, only one laboratory (U063) produced inconsistent and rather poor results for OCs in both ampules and spiked waters.

For the evaluation of relative performance of particpating laboratories, the results for ampules and spiked waters are summarized separately. Since it was obvious that the performance of spiked waters was less satisfactory as compared with that for ampules because of additional sample preparation steps such as extraction, concentration and cleanup. Besides, not all participating laboratories submitted the OC results for both ampules and spiked waters.

The participating laboratories, categorized from satisfactory to poor for ampules and spiked waters are summarized in Tables 4.2.5a and 4.2.5b, respectively. In Table 4.2.5a, the average performance (%) is the mean value for the average of % biased and % flagged obtained from QM-1 and QM-8. These tables provided the additonal information for the project leaders, manager and users of data on the comparability of their clint laboratories.

4.2.2 PCBs:

As shown in Table 4.2.2, few laboratories (U001,U063 and U079) have achieved consistency for producing satisfactory results for PCBs in both ampules and spiked waters. Although the PCB results for ampules were satisfactory generated by all participating laboratories in most cases, the poor results for spiked waters were produced by several laboratories (U014, U072, U075 and U092). It was obvious that less satisfactory results for spiked waters were attributed to sample preparation involved with extraction, concentration and cleanup steps since the results for ampules were satisfactory within ±25 % of design values by all participating laboratories.

The participating laboratories, categorized from satisfactory to poor for ampules and spiked waters are summarized in Tables 4.2.6a and 4.2.6b, respectively. These tables provided information on the comparability of the PCB results among participating laboratories.

4.2.3 CHs:

As shown in Table 4.2.3, the laboratory performance for CHs in various studies was less satisfactory as compared with those obtained for OCs and PCBs. Ony one laboratory (u086), which analyzed all the samples provided and most parameters requested, has achieved the consistency for producing the satisfactoy results in all matrices (ampules, waters and sediments). on the other hand, there were more poor results generated by participating laboratories in either matrices in these CH's interlaboratory studies.

The participating laboratories, categorized from satisfactory to poor for the relative performance of CHs in ampules, waters and sediments are summarized in Tables 4.2.7a, 4.2.7b and 4.2.7c, . respectively. These tables provided information on the comparability of CHs in various matrices among participating laboratories. In addition, as can be seen from these tables, the overall performance of CHs in ampules was satisfactory for all participating laboratories in most cases. While the overall performance in spiked waters and sediments were less satisfacotry as compared with that obtained in ampules.

4.2.4 PAHs:

As shown in Table 4.2.4, only one laboratory (U077) has achieved the consistency for producing satisfacotry results for PAHs in both ampules and spiked waters. However, less satisfactory results were generated by only two laboratories in either ampules (U063) or spiked waters (U075). The performance of U063 in QM-10 ~~were~~ Was very satisfactory for both ampules and spiked waters as

compared with ~~those~~ that obtained in QM-2. This extensively improvemnet for this laboratory had demonstrated that the impact of these interlaboratory studies was very valuable to help participating laboratories correcting their internal QA/QC problems.

The participating laboratories, categorized from satisfactory to poor for the relative performance of PAHs in ampules and waters are summarized in Tables 4.2.8a and 4.2.8b, respectively. These tables provided information on the comparability of PAHs in various matrices among participating laboratories.

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TABLE 2.1
QC Study Parameters
Interlaboratory Performance Evaluation of QC Studies
UGLCCS

Study	Test Samples	Parameters	Substrate
QM-1	4 ampuls	Aroclors	std solutions
	4 ampuls	O.C. Insecticides*	std solutions
	4 ampuls	Chlorinated Hydrocarbons**	std solutions
QM-2	4 ampuls	16 PAHs	std solutions
QM-3	5 sediments	10 Metals	sediment CRM or RM
QM-4	4 waters	23 Major Ions & Nutrients	water CRM
QM-5	4 waters	7 Metals	water CRM
QM-6	4 sediments	Chlorinated Hydrocarbons**	sediment CRM or RM
	2 ampuls	Chlorinated Hydrocarbons**	std solutions
QM-7	2 ampuls	Aroclors	std solutions
	2 ampuls	Chlorinated Hydrocarbons**	std solutions
	4 ampuls	Aroclors & Chlorinated Hydrocarbons**	spiking solutions & natural water
QM-8	4 ampuls	Chlorinated Insecticides*	std solution
	4 ampuls	Chlorinated Insecticides*	spiking solutions & natural water
QM-9	4 waters	Mercury	water RM
QM-10	2 ampuls	16 PAHs	std solutions
	4 ampuls	15 PAHs	spiking solutions & natural water
QM-11	4 waters	Cyanide	water RM
QM-12	4 waters	Total Phenol	water RM
QM-13	4 waters	5 Chlorophenols	std solutions
	2 oils		fish oils
	2 tissues		fish tissues

* HCB, (alpha, gamma) BHC' Mirex, pp'-DDE' pp'-DDD, pp'-DDT, heptachlor epoxide, dieldrin, (alpha, gamma) Chlordane, oxychlordane
(1,4;1,3,1,2) dichlorobenzene
(1,3,5,1,2,4,1,2,3) trichlorobenzene
(1,2,4,5,1,2,3,4) tetrachlorobenzene
pentachlorobenzene, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, octachlorostyrene

TABLE 2.2

Participants in the UGLCCS Performance Evaluation Studies

U.S. Laboratories

The Bionetics Corporation, (U.S. Environmental Protection Agency - Great Lakes National Program Office), Chicago, Illinois, USA.

Clarkson University, (U.S. Environmental Protection Agency - Large Lakes Research Station, Gross Ile, Michigan), Potsdam, New York, USA.

Detroit Water and Sewerage Department - Analytical Laboratory, Detroit Michigan, USA.

Great Lakes Environmental Research Laboratory - National Oceanic and Atmospheric Administration, Ann Arbor, Michigan, USA.

Michigan Department of Public Health - Centre for Environmental Health Science - Epidemiological Studies Laboratory, Lansing, Michigan, USA.

Michigan Department of Natural Resources, Lansing, Michigan, USA.

Raytheon Service Corporation (U.S. Environmental Protection Agency - Large Lakes Research Station), Grosse Ile, Michigan, USA.

University of Michigan - Great Lakes Research Division, (U.S. Environmental Protection Agency - Great Lakes National Program Office and Great Lakes Environmental Research Laboratory - National Oceanic and Atmospheric Administration) Ann Arbor, Michigan, USA.

U.S. Army Corps of Engineers - Environmental Analysis Branch, Detroit, Michigan, USA.

U.S. Geological Survey - National Water Quality Laboratory, Arvada, Colorado, USA.

Canadian Laboratories

Barringer Magenta Limited, Rexdale, Ontario, Canada.

Beak Analytical Services, Mississauga, Ontario Canada.

Mann Testing Laboratories, Mississauga, Ontario, Canada

National Water Research Institute, Environmental Contaminants Division - Inorganics Section, Burlington, Ontario, Canada.

National Water Resarch Institute, Environmental Contaminants Division - Organics-Pathways Section, Burlington, Ontario, Canada.

National Water Resarch Institute - Environmental Contaminants Division - Organics-Properties Section, Burlington, Ontario, Canada.

Ontario Ministry of Environment, London, Ontario, Canada.

Ontario Ministry of Environment - Inorganic Trace Contaminants Waters Unit, Rexdale, Ontario, Canada.

Ontario Ministry of Environment - Trace Organics Section - Drinking Water, Rexdale, Ontario, Canada.

Ontario Ministry of Environment - Trace Organics Section - Sediment and Biota, Rexdale, Ontario, Canada.

Ontario Ministry of Environment - Trace Organics Section - Wastewater, Rexdale, Ontario, Canada.

Ontario Ministry of Environment - Water Quality Section, Rexdale, Ontario, Canada.

Ontario Ministry of Environment - Thunder Bay, Ontario, Canada.

Wastewater Technology Centre, (Conservation and Protection, Toronto), Burlington, Ontario, Canada.

National Water Quality Laboratory, Burlington, Ontario, Canada.

Zenon Environmental Inc., Burlington, Ontario, Canada.

INTERLABORATORY PERFORMANCE EVALUATION or QC STUDIES

UGLCCS

TABLE 2.3 QC STUDY SCHEDULES

Study No.	No. of Questionnaires	No. of Participants	SEND OUT DATE Questionnaires	Samples	Reporting Deadline	No. of labs Reporting
)M-1	45	16	Dec 17/85	Jan 24/86	Mar 20/86 closed-July 4/86	9
)M-2	45	16	"	"	"	7
M-3	45	15	"	"	"	10
M-4	50	13	Jan 31/86	Feb 28/86	Apr 30/86 closed-Aug 8/86	10
1-5	50	14	"	"	"	11
1-6	50	12	"	"	"	7
1-7	55	16	Feb 28/86	Mar 27/86	May 15/86 closed-Sept 30/86	12
-8	55	14	"	"	"	10
-9	55	12	"	"	"	11
-10	59	14	Apr 2/86	May 1/86	May 30/86 closed-Oct 10/86	9
-11	59	10	"	"	"	7
-12	59	10	"	"	"	7
-13	55	6	May 9/86	Jun 24/86	Aug 1/86 closed-Oct 17/86	2

TABLE 4.1.1

Participants in OC's Interlaboratory Performance Evaluation Studies

Laboratory Code	Study Number	
	QM-1	QM-8
U001	X	X
U005	X	-
U009	X	-
U013	-	X
U014	X	X
U063	X	X
U072	X	X
U075	X	-
U077	-	X
U079	X	-
U086	X	X
U091	-	X
U092	-	X
U093	-	X

Note X: participated
-: not participated

TABLE 4.1.2a

Interlaboratory Medians for OCs with Identical Samples in Various Studies

Parameter No	Parameter	Design Value	QM-1		QM-8	
			105	108	801	802
			pg/μL			
1	HCB	51.8	39.5 (76.3)	40.0 (77.2)	41.9 (80.9)	45.1 (87.1)
2	α-BHC	26.2	23.6 (90.1)	22.1 (84.4)	23.9 (91.2)	23.4 (89.3)
3	γ-BHC	24.9	24.3 (97.6)	21.4 (85.9)	22.7 (91.2)	22.5 (90.4)
4	Mirex	54.3	49.3 (90.8)	48.0 (88.4)	47.0 (86.6)	48.0 (88.4)
5	P,P'-DOE	111.4	98.0 (88.0)	94.5 (84.8)	98.6 (88.5)	98.8 (88.7)
6	P,P'-DDD	50.4	43.1 (85.5)	36.2 (71.8)	43.0 (85.3)	44.0 (87.3)
7	P,P'-DDT	50.9	45.8 (90.0)	44.0 (86.4)	41.6 (81.7)	41.5 (81.5)
8	Heptachlor epoxide					
9	Dieldrin					
10	α-chlordane					
11	γ-chlordane					
12	Oxychlordane					

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.2b

Interlaboratory Medians for OCs with Identical Samples in Various Studies

Parameter No	Parameter	Design Value	QM-1		QM-8	
			106	107	803	804
			Median pg/uL			
1	HCB					
2	α-BHC					
3	γ-BHC					
4	Mirex					
5	P,P'-DDE					
6	P,P'-DDD					
7	P,P'-DDT					
8	Heptachlor epoxide	39.5	41.1 (104)	38.5 (97.5)	38.4 (97.2)	39.3 (99.5)
9	Dieldrin	43.0	41.9 (97.4)	39.0 (90.7)	42.0 (97.7)	41.0 (95.3)
10	α-chlordane	52.6	53.6 (102)	55.0 (105)	52.0 (98.9)	52.0 (98.9)
11	γ-chlordane	48.9	47.4 (96.9)	49.0 (100)	45.5 (93.0)	47.5 (97.1)
12	Oxychlordane	24.5	27.0 (110)	25.6 (104)	23.0 (93.9)	23.9 (97.6)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.3

Range and Average of Percent Recoveries for OCs in Various Studies

Parameter No.	Parameter	QM-1 (ampules)		QM-8 (ampules)		QM-8 (~~ampules~~ Waters)	
		Range	Average	Range	Average	Range	Average
		%					
1	HCB	76.3-77.2	76.8(2)	80.9-87.1	84.0(2)	60.6-77.2	69.8(4)
2	α-BHC	84.4-90.1	87.3(2)	89.3-91.2	90.3(2)	58.6-104	85.8(4)
3	γ-BHC	85.9-97.6	91.8(2)	90.4-91.2	90.8(2)	78.3-88.4	84.7(4)
4	Mirex	88.4-90.8	89.6(2)	86.6-88.4	87.5(2)	88.2-98.5	93.8(4)
5	p,p'-DDE	84.8-88.0	86.4(2)	88.5-88.7	88.6(2)	93.5-114	104(4)
6	p,p'-DDD	71.8-85.5	78.7(2)	85.3-87.3	86.3(2)	87.3-107	95.9(4)
7	p,p'-DDT	86.4-90.0	88.2(2)	81.5-81.7	81.6(2)	74.8-96.6	83.4(4)
8	Heptachlor epoxide	97.5-104	101(2)	97.2-99.5	98.4(2)	93.2-117	105(4)
9	Dieldrin	90.7-97.4	94.1(2)	95.3-97.7	96.5(2)	83.2-96.3	91.7(4)
10	α-chlordane	102-105	104(2)	98.9-98.9	98.9(2)	87.6-99.0	93.3(4)
11	γ-chlordane	96.9-100	98.5(2)	93.0-97.1	95.1(2)	86.1-91.0	88.9(4)
12	Oxychlordane	104-110	107(2)	93.9-97.6	95.8(2)	77.7-88.6	84.9(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values~~ number of samples.

TABLE 4.1.4

Precision of Interlaboratory Results for OCs in Various Studies
(Percent RSD)

Parameter No.	Parameter	QM-1 (ampules) Range	QM-1 (ampules) Average	QM-8 (ampules) Range	QM-8 (ampules) Average	QM-8 (~~ampules~~ Waters) Range	QM-8 (~~ampules~~ Waters) Average
		%					
1	HCB	21.8-32.5	27.2(2)	35.6-36.4	36.0(2)	26.1-49.6	41.0(4)
2	α-BHC	9.4-16.7	13.1(2)	15.2-15.3	15.3(2)	14.8-48.2	37.0(4)
3	γ-BHC	11.1-15.0	13.2(2)	16.2-19.7	18.0(2)	23.0-44.5	27.7(4)
4	Mirex	13.3-14.8	14.1(2)	6.0-7.0	6.5(2)	17.3-42.2	29.0(4)
5	p,p'-DDE	5.3-8.0	6.7(2)	9.1-10.9	10.0(2)	13.1-38.6	26.1(4)
6	p,p'-DDD	33.6-33.9	33.8(2)	16.4-18.9	17.7(2)	6.9-53.5	28.0(4)
7	p,p'-DDT	14.1-15.1	14.6(2)	10.8-11.1	11.0(2)	28.3-41.0	34.4(4)
8	Heptachlor epoxide	18.4-31.8	25.1(2)	26.0-26.2	26.1(2)	28.9-38.4	34.0(4)
9	Dieldrin	8.6-11.4	10.0(2)	10.4-12.7	11.6(2)	11.9-26.2	20.2(4)
10	α-chlordane	6.7-8.2	7.5(2)	8.5-10.5	9.5(2)	10.9-32.8	21.7(4)
11	γ-chlordane	13.4-17.5	15.5(2)	8.5-9.2	8.9(2)	8.9-28.6	18.1(4)
12	Oxychlordane	19.2-21.3	20.3(2)	14.9-17.5	16.2(2)	12.5-67.0	36.2(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values.~~ number of samples.

TABLE 4.1.5

Participants in PCBs Interlaboratory Performance Evaluation Studies

Laboratory Code	Study Number	
	QM-1	QM-7
U001	X	X
U005	X	—
U009	X	-
U013	-	X
U014	X	X
U063	X	X
U072	X	X
U075	X	X
U077	-	X
U079	X	X
U086	X	X
U091	-	X
U092	-	X
U093	-	X

Note X: participated
-: not participated

TABLE 4.1.6

Interlaboratory Medians for PCBs with Identical Samples in Various Studies

Parameter	Design Value	QM-1		QM-7	
		102	104	701	702
		pg/μL			
PCBs	180	190 (106)	200 (111)	192 (107)	198 (110)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.7

Range and Average of Percent Recoveries for PCBs in Various Studies

Parameter	QM-1 (ampules)		QM-7 (ampules)		QM-7 (waters)	
	Range	Average	Range	Average	Range	Average
	%					
PCBs	96.1-111	103(4)	107-110	109(2)	76.3-93.5	84.0(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values.~~ number of samples.

TABLE 4.1.8

Precision of Interlaboratory Results for PCBs in Various Studies
(RSD)

Parameter	QM-1 (ampules)		QM-7 (ampules)		QM-7 (waters)	
	Range	Average	Range	Average	Range	Average
	%					
PCBs	12.4-20.8	16.8(4)	13.6-17.6	15.6(2)	17.8-41.4	28.9(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values.~~ number of samples.

TABLE 4.1.9

Participants in CHs Interlaboratory Performance Evaluation Studies

Laboratory Code	Study Number		
	QM-1	QM-6	QM-7
U001	X	X	X
U005	X	X	-
U009	X	X	-
U013	-	-	X
U014	X	X	X
U063	X	-	X
U072	X	X	X
U075	X	-	X
U077	-	-	X
U079	X	-	X
U086	X	X	X
U091	-	-	X
U092	-	-	X
U093	-	-	X

Note X: participated
-: not participated

TABLE 4.1.10a

Interlaboratory Medians for CHs with Identical Samples in Various Studies

Parameter No	Parameter	Design Value	QM-1		QM-6	QM-7	
			110	111	606	703	704
			pg/μL				
1	1,4-DCB	152	146.0 (96.1)	143.0 (94.1)	150 (98.7)	160 (105)	160 (105)
2	1,3-DCB	143	134.0 (93.7)	131.0 (91.6)	130 (90.9)	130 (90.9)	140 (97.9)
3	1,2-DCB	158	155.0 (98.1)	150.0 (94.9)	160 (101)	170 (108)	170 (108)
4	1,3,5-TCB	32.0	23.7 (74.1)	23.5 (73.4)	25.5 (79.7)	25.6 (80.0)	27.0 (84.4)
5	1,2,4-TCB	30.0	24.05 (80.2)	23.65 (78.8)	24.0 (80.0)	27.0 (90.0)	28.0 (93.3)
6	1,2,3-TCB	31.2	24.4 (78.2)	24.1 (77.2)	26.5 (84.9)	28.5 (91.3)	29.0 (92.9)
7	1,2,4,5-TeCB	15.1	8.5 (56.3)	9.04 (59.9)	13.0 (86.1)	12.5 (82.2)	13.0 (85.5)
8	1,2,3,4-TeCB	14.7	11.1 (75.5)	11.0 (74.8)	13.5 (91.8)	14.0 (95.2)	15.0 (102)
9	PeCB	14.8	12.6 (85.1)	12.1 (81.8)	13.5 (91.2)	14.0 (94.6)	14.0 (94.6)
10	HCB	7.77	7.20 (92.7)	6.70 (86.2)	6.94 (89.3)	7.0 (90.1)	7.32 (94.2)
11	HCE	6.02	5.50 (92.2)	5.50 (92.2)	5.60 (93.0)	6.00 (99.7)	6.00 (99.7)
12	HCBD	7.42	7.10 (95.7)	6.80 (91.6)	6.60 (88.9)	8.00 (108)	8.00 (108)
13	OCS	15.6	13.75 (88.1)	12.85 (94.5)	13.0 (83.3)	14.0 (89.7)	14.0 (89.7)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.10b

Interlaboratory Medians for CHs with Identical Samples in Various Studies

Parameter No	Parameter	Design Value	QM-1		QM-6
			109	112	605
			pg/μL		
1	1,4-DCB	1013	958.0 (94.6)	978.0 (96.5)	1000 (98.7)
2	1,3-DCB	952	890.5 (93.5)	903.0 (94.9)	1020 (107)
3	1,2-DCB	1050	1001.5 (95.4)	957.0 (91.1)	1200 (114)
4	1,3,5-TCB	213	152.0 (71.4)	142.5 (66.9)	187 (87.8)
5	1,2,4-TCB	200	183.5 (91.8)	146.0 (73.0)	203 (102)
6	1,2,3-TCB	208	155.0 (74.5)	144.0 (69.2)	180 (86.5)
7	1,2,4,5-TeCB	101	55.25 (54.7)	62.0 (61.4)	86.0 (85.1)
8	1,2,3,4-TeCB	97.9	70.1 (71.6)	67.45 (68.9)	89.0 (90.9)
9	PeCB	98.6	77.15 (78.2)	74.4 (75.5)	91.5 (92.8)
10	HCB	51.8	44.6 (86.1)	45.0 (86.9)	47.5 (91.7)
11	HCE	40.1	37.9 (94.5)	39.75 (99.1)	40.0 (99.8)
12	HCBD	49.5	46.6 (94.1)	46.8 (94.5)	47.0 (94.9)
13	OCS	104	85.75 (82.5)	89.5 (86.1)	84.5 (81.3)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.11

Range and Average of Percent Recoveries for CHs in Various Studies

Parameter No.	Parameter	QM-1 (ampules)		QM-6 (ampules)		QM-7 (ampules)		QM-7 (waters)		QM-6 (sediments)	
		Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
		%									
1	1,4-DCB	94.1-96.5	95.3(4)	98.7-98.7	98.7(2)	105-105	105(2)	49.8-123	79.0(4)	103-169	136(4)
2	1,3-DCB	91.6-94.9	93.4(4)	90.9-107	99.0(2)	90.9-97.9	94.4(2)	42.2-70.5	54.0(4)	60.3-111	83.7(4)
3	1,2-DCB	91.1-98.1	94.9(4)	101-114	108(2)	108-108	108(2)	70.5-151	111(4)	113-230	172(4)
4	1,3,5-TCB	66.9-74.1	71.5(4)	79.7-87.8	83.8(2)	80.0-84.4	82.2(2)	32.3-78.5	54.4(4)	63.3-77.7	71.1(4)
5	1,2,4-TCB	73.0-91.8	81.0(4)	80.0-102	91.0(2)	90.0-93.3	91.7(2)	54.7-75.0	63.9(4)	78.1-137	107(4)
6	1,2,3-TCB	69.2-78.2	74.8(4)	84.9-86.5	90.7(2)	91.3-92.9	92.1(2)	69.6-76.9	74.3(4)	62.5-80.0	71.3(4)
7	1,2,4,5-TeCB	54.7-61.4	58.1(4)	85.1-86.1	85.6(2)	82.2-85.5	83.9(2)	67.6-164	112(4)	66.1-89.3	79.1(4)
8	1,2,3,4-TeCB	68.9-75.5	72.7(4)	90.9-91.8	91.4(2)	95.2-102	98.6(2)	54.3-68.4	61.3(4)	56.1-82.2	69.6(4)
9	PeCB	75.5-85.1	80.2(4)	91.2-92.8	92.0(2)	94.6-94.6	94.6(2)	76.5-87.0	79.5(4)	83.6-100	91.7(4)
10	HCB	86.1-92.7	88.0(4)	89.3-91.7	90.5(2)	90.1-94.2	92.2(2)	76.4-92.3	83.6(4)	97.0-105	102(4)
11	HCE	92.2-99.1	94.5(4)	93.0-99.8	96.4(2)	99.7-99.7	99.7(2)	54.5-63.6	58.7(4)	NC	NC
12	HCBD	91.6-95.7	94.0(4)	88.9-94.9	91.9(2)	108-108	~~107~~ 103(2)	44.0-50.5	45.9(4)	70.4-96.6	81.7(4)
13	OCS	82.5-94.5	87.8(4)	81.3-83.3	82.3(2)	89.7-89.7	~~109~~ 89.7(2)	82.7-98.1	93.3(4)	86.7-103	97.1(4)

Note: The numbers in parentheses are number of samples.

TABLE 4.1.12

Precision of Interlaboratory Results for CHs in Various Studies

(RSD)

Parameter No.	Parameter	QM-1 (ampules)		QM-6 (ampules)		QM-7 (ampules)		QM-7 (waters)		QM-6 (sediments)	
		Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
		%									
1	1,4-DCB	20.7-32.7	24.9(4)	19.6-26.5	23.1(2)	12.8-16.3	14.6(2)	40.7-98.3	60.5(4)	42.7-71.9	58.6(4)
2	1,3-DCB	24.9-30.9	27.7(4)	16.8-28.3	22.6(2)	36.7-36.7	36.7(2)	6[illegible].7-62.3	40.4(4)	31.8-50.1	40.7(4)
3	1,2-DCB	19.4-31.2	25.1(4)	24.5-28.8	26.7(2)	16.9-18.5	17.7(2)	42.3-92.3	66.6(4)	0.4-80.8	48.8(4)
4	1,3,5-TCB	36.2-54.1	44.0(4)	15.7-19.9	17.8(2)	40.9-42.3	41.6(2)	44.4-83.2	59.4(4)	29.6-53.8	39.3(4)
5	1,2,4-TCB	27.4-43.7	35.4(4)	27.5-30.1	28.8(2)	14.0-14.9	14.5(2)	19.4-40.1	30.1(4)	23.7-46.7	37.7(4)
6	1,2,3-TCB	20.0-35.0	27.5(4)	17.8-25.6	21.7(2)	19.4-21.0	20.2(2)	15.4-54.0	30.6(4)	35.4-60.7	42.0(4)
7	1,2,4,5-TeCB	38.5-51.4	44.9(4)	18.9-22.4	20.7(2)	10.3-13.8	12.1(2)	20.6-71.6	44.8(4)	34.4	34.4(1)
8	1,2,3,4-TeCB	20.3-36.1	27.6(4)	21.0-24.0	22.5(2)	13.6-14.9	14.3(2)	15.1-35.1	22.9 (4)	9.4-28.4	19.9(4)
9	PeCB	19.3-28.9	23.0(4)	16.2-17.3	16.8(2)	15.4-16.2	15.8(2)	19.0-46.3	30.9 (4)	5.8-24.2	16.3(4)
10	HCB	15.2-31.8	25.3(4)	17.9-18.0	18.0(2)	24.2-27.4	25.8(2)	33.0-68.1	50.8(4)	8.3-34.5	20.5(4)
11	HCE	3.6-37.5	24.0(4)	13.7-27.2	20.5(2)	10.0-10.0	10.0(2)	[illegible]-65.7	53.4(4)	-	-
12	HCBD	28.5-33.1	31.3(4)	15.6-34.1	24.9(2)	10.1-11.4	10.8(2)	35.9-54.2	41.9(4)	4.1-29.3	14.3(4)
13	OCS	10.1-24.3	16.9(4)	14.1-22.7	18.4(2)	25.5-26.2	25.9(2)	33.5-83.6	57.1(4)	18.6-36.9	25.6(4)

Note: The numbers in parentheses are number of samples.

TABLE 4.1.13

Participants in PAH's Interlaboratory Performance Evaluation Studies

Laboratory Code	Study Number	
	QM-2	QM-10
U001	X	X
U005	X	-
U009	X	-
U014	-	X
U063	X	X
U072	X	X
U075	-	X
U077	-	X
U073	-	X
U079	X	X
U085	X	-
U093	-	X

Note X: participated
-: not participated

TABLE 4.1.14

Interlaboratory Medians for PAHs with Identical Samples in Various Studies

Parameter No	Parameter	Design Value	QM-2		QM-10
			203	204	1002
			ng/μL ~~median~~		
1	naphthalene	0.659 ~~0.569~~	0.532 (80.7)	0.600 (91.0)	0.600 (91.0)
2	acenapthylene	0.953	0.620 (65.1)	0.601 (63.1)	0.820 (86.0)
3	acenaphthene	1.09	0.820 (75.2)	0.775 (71.1)	0.955 (87.6)
4	fluorene	1.17	0.800 (68.4)	0.800 (68.4)	0.925 (79.1)
5	phenanthrene	2.54	1.44 (56.7)	1.47 (57.9)	1.90 (74.8)
6	anthracene	0.334	0.305 (91.3)	0.330 (98.8)	0.268 (80.2)
7	fluoranthene	4.80	3.27 (68.1)	3.70 (77.1)	4.40 (91.7)
8	pyrene	4.80	3.60 (75.0)	3.76 (78.3)	4.42 (92.1)
9	benzo(a)anthracene	2.08	1.40 (67.3)	1.47 (70.7)	1.73 (83.2)
10	chrysene	1.89	1.18 (62.4)	1.20 (63.5)	1.76 (93.1)
11	benzo(b)fluoranthene	0.929	0.921 (99.1)	0.730 (78.6)	0.800 (86.1)
12	benzo(k)fluoranthene	0.535	0.545 (102)	0.520 (97.2)	0.460 (86.0)
13	benzo(a)pyrene	0.954	1.06 (111)	0.977 (102)	0.783 (82.1)
14	indeno(1,2,3-CD)-pyrene	0.889	0.771 (80.0)	0.691 (77.7)	0.800 (90.0)
15	dibenzo(a,h)-anthracene	1.00	1.00 (100)	0.835 (83.5)	0.810 (81.0)
16	benzo(g,h,i)-perylene	0.947	1.01 (107)	0.935 (98.7)	0.900 (95.0)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.15

Range and Average of Percent Recoveries for PAHs in Various Studies

Parameter No.	Parameter	QM-2 (ampules)		QM-10 (ampules)		QM-10 (waters)	
		Range	Average	Range	Average	Range	Average
		%					
1	naphthalene	80.7-116	93.1(4)	91.0-113	102(2)	73.6-102	83.6(4)
2	acenaphthylene	~~61.3~~ 63.1-96.5	79.8(4)	67.3-86.0	76.7(2)	60.9-74.6	65.4(4)
3	acenaphthene	71.1-81.2	76.7(4)	84.2-87.6	85.9(2)	55.6-69.7	64.3(4)
4	fluorene	68.4-78.8	72.8(4)	79.1-89.3	84.2(2)	60.0-67.6	64.5(4)
5	phenanthrene	56.7-75.6	66.1(4)	74.8-82.7	78.8(2)	70.1-75.6	71.9(4)
6	anthracene	89.6-98.8	92.4(4)	80.2-93.7	87.0(2)	77.9-89.8	83.0(4)
7	fluoranthene	68.1-84.2	77.6(4)	87.5-91.7	89.6(2)	69.1-84.2	75.4(4)
8	pyrene	75.0-90.8	81.9(4)	90.8-92.1	91.5(2)	74.8-85.7	81.6(4)
9	benzo(a)anthracene	~~78.6-102~~ 67.3-96.0	~~94.4~~ 81.9(4)	~~80.6-86.1~~ 83.2-118	~~83.4~~ 101(2)	~~73.2-80.5~~ 72.6-78.9	76.0(4)
10	chrysene	62.4-86.9	71.6(4)	93.1-115	104(2)	74.6-85.3	80.3(4)
11	benzo(b)fluoranthene	78.6-102	94.4(4)	80.6-86.1	83.4(2)	73.2-80.5	76.3(4)
12	benzo(k)fluoranthene	82.2-102	93.7(4)	86.0-92.1	89.1(2)	58.2-94.0	77.2(4)
13	benzo(a)pyrene	95.5-111	104(4)	82.1-85.3	83.7(2)	77.6-86.0	81.9(4)
14	indeno(1,2,3-CD)-pyrene	77.7-95.3	86.0(4)	90.0-100	95.0(2)	73.1-88.8	81.4(4)
15	dibenzo(a,h)-anthracene	83.5-100	91.0(4)	81.0-90.8	85.9(2)	73.0-92.2	80.9(4)
16	benzo(g,h,i)-perylene	95.7-107	99.6(4)	95.0-96.0	95.5(2)	79.2-98.3	88.2(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values.~~ number of samples.

TABLE 4.1.16

Precision of Interlaboratory Results for PAHs in Various Studies

(RSD)

Parameter No.	Parameter	QM-2 (ampules)		QM-10 (ampules)		QM-10 (water)	
		Range	Average	Range	Average	Range	Average
		%					
1	naphthalene	7.4-50.7	33.0(4)	19.8-33.9	26.7(2)	14.2-53.2	43.2(4)
2	acenapthylene	14.0-41.8	31.0(4)	32.9-39.3	36.1(2)	11.6-42.6	30.8(4)
3	acenaphthene	18.5-44.3	33.3(4)	28.9-31.3	30.1(2)	24.3-44.0	30.1(4)
4	fluorene	17.6-64.7	40.4(4)	23.4-27.2	25.3(2)	32.3-45.1	36.1(4)
5	phenanthrene	13.9-44.0	27.0(4)	17.8-24.4	21.1(2)	14.1-43.1	23.3(4)
6	anthracene	14.3-49.3	25.9(4)	15.6-17.7	16.7(2)	16.7-53.6	37.2(4)
7	fluoranthene	10.7-47.4	28.1(4)	15.9-21.7	18.8(2)	11.6-53.0	31.5(4)
8	pyrene	8.8-38.0	~~10.2~~ 20.1 (4)	23.1-25.6	24.4(2)	16.1-23.0	19.1(4)
9	benzo(a)anthracene	16.0-63.2	35.8(4)	10.4-21.6	16.0(2)	4.7-33.6	22.9(4)
10	chrysene	16.7-68.2	40.1(4)	43.1-49.5	46.3(2)	28.8-34.7	32.7(4)
11	benzo(b)fluoranthene	7.1-81.9	39.0(4)	13.2-17.8	15.5(2)	21.0-36.5	29.1(4)
12	benzo(k)fluoranthene	11.0-88.7	48.9(4)	18.7-36.8	27.8(2)	25.5-58.0	40.2(4)
13	benzo(a)pyrene	13.3-52.5	26.0(4)	4.8-33.2	19.0(2)	5.3-38.5	25.7(4)
14	indeno(1,2,3-CD)-pyrene	16.3-81.0	40.6(4)	12.3-31.8	22.1(2)	12.2-23.2	18.1(4)
15	dibenzo(a,h)-anthracene	12.0-50.5	25.2(4)	8.1-38.6	23.4(2)	22.3-28.2	25.0(4)
16	benzo(g,h,i)-perylene	11.5-39.0	23.6(4)	4.0-33.2	18.6(2)	12.1-16.8	13.8(4)

Note: The numbers in parentheses are ~~the percent recoveries of design values.~~ number of samples.

TABLE 4.2.1

Comparison of Laboratory Performance for OCs in Various Studies

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of* Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of+ Results Flagged	% of Results Flagged		
U001	QM-1	Ampules	11	0.0	0.0	22	1.0	4.5	2.3	A
	QM-8	Ampules	11	0.0	0.0	22	1.0	4.5	2.3	A
	QM-8	Waters	11	0.5	4.5	44	3.5	8.0	6.3	A
U005	QM-1	Ampules	11	1.5	13.6	22	3.5	15.9	14.8	A
U009	QM-1	Ampules	12	1.5	12.5	24	3.5	14.6	13.6	A
U013	QM-8	Ampules	11	0.5	4.5	22	1.5	6.8	5.7	A
	QM-8	Waters	9	5.5	61.1	18	8.5	47.2	54.2	C
U014	QM-1	Ampules	10	1.5	15.0	20	3.0	15.0	15.0	A
	QM-8	Ampules	10	2.0	20.0	20	4.0	20.0	20.0	A
	QM-8	Waters	10	1.5	15.0	40	5.0	12.5	~~13.8~~ 13.5	A
U063	QM-1	Ampules	12	5.0	41.7	24	8.0	33.3	37.5	B
	QM-8	Ampules	12	12.0	100	24	24.0	100	100	C
	QM-8	Waters	12	11.0	91.6	48	43.0	89.6	90.6	C
U072	QM-1	Ampules	12	0.0	0.0	24	0.0	0.0	0.0	A
	QM-8	Ampules	12	0.0	0.0	24	0.0	0.0	0.0	A
	QM-8	Waters	12	1.0	8.3	48	5.5	11.5	9.9	A

TABLE 4.2.1 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U075	QM-1	Ampules	1	0.5	50.0	2	0.5	25.0	37.5	B
U077	QM-8	Ampules	12	0.0	0.0	24	0.5	2.1	1.1	A
	QM-8	Waters	12	3.5	29.2	48	11.5	24.0	26.6	B
U079	QM-1	Ampules	4	0.0	0.0	8	0.0	0.0	0.0	A
U086	QM-1	Ampules	8	2.5	31.3	16	6.0	37.5	34.4	B
	QM-8	Ampules	8	0.5	6.3	16	1.0	6.3	6.3	A
	QM-8	Waters	8	3.0	37.5	32	10.5	32.8	35.2	B
U091	QM-8	Ampules	12	1.0	8.3	24	2.0	8.3	8.3	A
	QM-8	Waters		NA			NA			
U092	QM-8	Ampules	12	1.5	12.5	24	3.0	12.5	12.5	A
	QM-8	Waters	12	2.0	16.7	48	9.0	18.8	17.8	A
U093	QM-8	Ampules	12	1.5	12.5	24	3.0	12.5	12.5	A
	QM-8	Waters	12	4.5	37.5	48	16.5	34.4	36.0	B

Note: * L or H of a bias was counted as half of a bias
+ L or H of a flag was counted as half of a flag

TABLE 4.2.2 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U075	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	1.0	100	2	2.0	100	100	C
U077	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	1.0	25.0	12.5	A
U079	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.5	25.0	12.5	A
	QM-7	Waters	1	0.0	0.0	4	1.5	37.5	18.8	A
U086	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.5	50.0	2	1.5	75.0	62.5	C
	QM-7	Waters	1	0.0	0.0	4	0.5	12.5	6.3	A
U091	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters		NA			NA			
U092	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.5	50.0	4	3.5	87.5	68.8	C
U093	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters		NA			NA			

TABLE 4.2.2

Comparison of Laboratory Performance for PCBs in Various Studies

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U001	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	0.5	12.5	6.3	A
U005	QM-1	Ampules	1	0.0	0.0	4	1.0	25.0	12.5	A
U009	QM-1	Ampules	1	0.0	0.0	4	0.5	12.5	6.3	A
U013	QM-7	Ampules	1	0.5	50.0	2	0.5	25.0	37.5	B
	QM-7	Waters		NA			NA			
U014	QM-1	Ampules	1	0.5	50.0	4	2.0	50.0	50.0	B
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.5	50.0	2	1.5	75.0	62.5	C
U063	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	1.0	25.0	12.5	A
U072	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	1.0	100	4	4.0	100	100	C

TABLE 4.2.3

Comparison of Laboratory Performance for CHs in Various Studies

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U001	QM-1	Ampules	9	1.5	16.7	36	6.5	18.1	17.4	A
	QM-6	Ampules	11	3.0	27.2	22	7.0	31.8	29.5	B
	QM-7	Ampules	11	2.0	18.2	22	4.0	18.2	18.2	A
	QM-7	Waters	11	6.0	54.5	44	33.5	76.1	65.3	C
	QM-6	Sediments	11	4.0	36.4	44	19.0	43.2	39.8	B
U005	QM-1	Ampules	4	2.0	50.0	13	3.5	26.9	38.5	B
	QM-6	Ampules	6	4.5	75.0	10	6.0	60.0	67.5	C
	QM-6	Sediments	6	6.0	100	23	23.0	100	100	C
U009	QM-1	Ampules	10	4.0	40.0	40	18.5	46.3	43.2	B
	QM-6	Ampules	10	1.0	10.0	20	2.0	10.0	10.0	A
	QM-6	Sediments	9	4.5	50.0	36	21.0	58.3	54.2	C
U012	QM-7	Ampules	3	1.0	33.3	6	2.0	33.3	33.3	B
	QM-7	Waters	3	2.0	66.7	6	4.0	66.7	66.7	C
U014	QM-1	Ampules	7	1.0	14.2	28	7.0	25.0	19.6	A
	QM-6	Ampules	7	1.5	21.4	10	3.5	35.0	28.2	B
	QM-7	Ampules	7	1.0	14.2	14	2.0	14.3	14.3	A
	QM-7	Waters	4	3.0	75.0	14	9.5	67.9	71.5	C
	QM-6	Sediments	2	1.0	50.0	6	2.0	33.3	41.7	B

TABLE 4.2.3 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U063	QM-1	Ampules	10	2.5	25.0	30	11.5	38.3	31.7	B
	QM-7	Ampules	11	6.5	59.1	22	13.0	59.1	59.1	C
	QM-7	Waters	11	11.0	100	42	35.0	83.3	91.7	C
U072	QM-1	Ampules	13	0.0	0.0	52	0.5	1.0	0.5	A
	QM-6	Ampules	13	0.0	0.0	26	0.0	0.0	0.0	A
	QM-7	Ampules	13	0.0	0.0	26	0.0	0.0	0.0	A
	QM-7	Waters	6	3.5	58.3	18	11.0	61.1	59.7	C
	QM-7	Sediments	5	1.0	20.0	18	4.0	22.2	21.2	A
U075	QM-1	Ampules	2	0.0	0.0	8	0.0	0.0	0.0	A
	QM-7	Ampules		NA			NA			
	QM-7	Waters	2	2.0	100	8	8.0	100	100	C
U077	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	0.5	12.5	6.3	A
U079	QM-1	Ampules		NA			NA			
	QM-7	Ampules		NA			NA			
	QM-7	Waters		NA			NA			

TABLE 4.2.3 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U086	QM-1	Ampules	13	6.0	46.2	52	23.0	44.2	45.2	B
	QM-6	Ampules	13	0.0	0.0	26	0.0	0.0	0.0	A
	QM-7	Ampules	13	0.0	0.0	26	0.0	0.0	0.0	A
	QM-7	Waters	13	3.0	23.1	52	13.0	25.0	24.1	A
	QM-6	Sediments	12	1.5	12.5	48	7.5	14.1	14.1	A
U091	QM-7	Ampules	2	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Waters		NA			NA			
U092	QM-7	Ampules	10	2.0	20.0	20	4.0	20.0	20.0	A
	QM-7	Waters	10	4.0	40.0	40	16.0	40.0	40.0	B
U093	QM-7	Ampules	10	1.5	15.0	20	3.0	15.0	15.0	A
	QM-7	Waters	10	6.5	65.0	37	23.5	63.5	64.3	C

TABLE 4.2.4

Comparison of Laboratory Performance for PAHs in Various Studies

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U001	QM-2	Ampules	16	7.5	46.9	58	24.0	41.4	44.2	B
	QM-10	Ampules	6	2.5	41.6	12	4.5	37.5	39.6	B
	QM-10	Waters	6	2.0	33.3	24	7.0	29.2	31.3	B
U005	QM-2	Ampules	12	2.5	20.8	38	9.0	23.6	22.2	A
U009	QM-2	Ampules	16	3.0	18.8	64	11.0	17.2	18.0	A
U014	QM-10	Ampules		NA			NA			
	QM-10	Waters	insufficient usable data for evaluation							
U063	QM-2	Ampules	15	8.0	53.3	59	34.0	57.6	55.5	C
	QM-10	Ampules	14	1.5	10.7	28	4.5	16.1	13.4	A
	QM-10	Waters	14	1.0	7.1	56	5.0	8.9	8.0	A
U072	QM-2	Ampules	9	1.0	11.1	34	2.5	7.4	9.3	A
	QM-10	Ampules	10	0.5	5.0	20	3.0	15.0	10.0	A
	QM-10	Waters	10	3.0	30.0	38	16.5	43.4	36.7	B
U075	QM-10	Ampules		NA			NA			
	QM-10	Waters	10	6.0	60.0	39	20.0	51.3	55.7	C

TABLE 4.2.4 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U077	QM-10	Ampules	16	3.5	21.9	27	6.0	22.2	22.1	A
	QM-10	Waters	12	2.5	20.8	40	11.0	27.5	24.2	A
U078	QM-10	Ampules	16	1.5	9.4	32	3.0	9.4	9.4	A
	QM-10	Waters	16	4.5	28.1	64	~~13.5~~ 17.5	27.3	27.7	B
U079	QM-2	Ampules	16	3.5	21.9	62	21.5	34.7	28.3	B
	QM-10	Ampules	16	3.5	21.9	32	5.5	17.2	19.6	A
	QM-10	Waters	15	6.5	43.3	59	22.0	37.3	40.3	B
U093	QM-10	Ampules	16	7.0	43.8	32	13.5	42.2	43.0	B
	QM-10	Waters	15	6.5	43.3	60	25.5	42.5	42.9	B
U085	QM-2	Ampules	16	3.5	21.9	50	18.0	36.0	29.0	B

Table 4.2.5a

Summary of Relative Performance of Laboratories for OCs in Ampules

Lab Code	Average* Performance (%)	Number of Studies	Comment
U072	0.0	2	A
U079**	0.0	1	A
U077	1.1	1	A
U001	2.3	2	A
U013	5.7	1	A
U091	8.3	1	A
U092	12.5	1	A
U093	12.5	1	A
U009	13.6	1	A
U005	14.8	1	A
U014	20.0	2	A
U086	20.4	2	A
U075**	37.5	1	B
U063	68.8	2	C

Note: * Average Performance (%) is mean value for the average of % biased and % flagged obtained from QM-1 and QM-8.
** Less than 4 parameters were analyzed.

Table 4.2.5b
Summary of Relative Performance of Laboratories for OCs in Waters

Lab Code	Average of % biased and % flagged (%)	Number of Stidies	Comment
U001	6.3	1	A
U072	9.9	1	A
U014	13.8	1	A
U092	17.8	1	A
U077	26.6	1	B
U086	35.2	1	B
U093	36.0	1	B
U013	54.2	1	C
U063	90.6	1	C

Table 4.2.6a
Summary of Relative Performance of Laboratories
for PCBs in Ampules

Lab Code	Average* Performance (%)	Number of Studies	Comment
U001	0.0	2	A
U063	0.0	2	A
U072	0.0	2	A
U075	0.0	2	A
U077	0.0	1	A
U091	0.0	1	A
U092	0.0	1	A
U093	0.0	1	A
U079	6.3	2	A
U009	6.3	1	A
U005	12.5	1	A
U014	25.0	2	A
U086	31.3	2	B
U013	37.5	1	B

Note: * Average Performance (%) is mean value for the average of % biased and % flagged obtained from QM-1 and QM-7.

Table 4.2.6b
Summary of Relative Performance of Laboratories for PCBs in Waters

Lab Code	Average of % biased and % flagged (%)	Number of Studies	Comment
U001	6.3	1	A
U086	6.3	1	A
U063	12.5	1	A
U077	12.5	1	A
U079	18.8	1	A
U014	62.5	1	C
U092	68.8	1	C
U072	100	1	C
U075	100	1	C

Table 4.2.7a
Summary of Relative Performance of Laboratories for CHs in Ampules

Lab Code	Average* Performance (%)	Number of Studies	Comment
U075**	0.0	1	A
U077**	0.0	1	A
U091**	0.0	1	A
U072	1.7	3	A
U093	15.0	1	A
U086	15.1	3	A
U092	20.0	1	A
U014	20.7	3	A
U001	21.7	3	A
U009	26.6	2	B
U013	33.3	1	B
U063	45.4	2	B
U005	53.0	2	C

Note: * Average Performance (%) is mean value for the average of % biased and % flagged obtained from QM-1, QM-6 and QM-7.
** Less than 4 parameters were analyzed.

Table 4.2.7b
Summary of Relative Performance of Laboratories for CHs in Waters

Lab Code	Average of % biased and % flagged (%)	Number of Studies	Comment
U077**	0.0	1	A
U086	24.1	1	A
U092	40.0	1	B
U072	59.7	1	C
U093	64.3	1	C
U001	65.3	1	C
U013**	66.7	1	C
U014**	71.5	1	C
U063	91.7	1	C
U075**	100	1	C

Note: ** Less than 4 parameters were analyzed.

Table 4.2.7c
Summary of Relative Performance of Laboratories for CHs in Sediments

Lab Code	Average of % biased and % flagged (%)	Number of Studies	Comment
U086	14.1	1	A
U072	21.2	1	A
U001	39.8	1	B
U014**	41.7	1	B
U009	54.2	1	C
U005	100	1	C

Note: ** Less than 4 parameters were analyzed.

Table 4.2.8a
Summary of Relative Performance of Laboratories for PAHs in Ampules

Lab Code	Average* Performance (%)	Number of Studies	Comment
U078	9.4	1	A
U072	9.7	2	A
U009	18.0	1	A
U077	22.1	1	A
U005	22.2	1	A
U079	24.0	2	A
U085	29.0	1	B
U063	34.5	2	B
U001	41.9	2	B
U093	43.0	1	B

Note: * Average Performance (%) is mean value for the average of % biased and % flagged obtained from QM-2 and QM-10.

Table 4.2.8b
Summary of Relative Performance of Laboratories for PAHs in Waters

Lab Code	Average of % biased and % flagged (%)	Number of Studies	Comment
U063	8.0	1	A
U077	24.2	1	A
U078	27.7	1	B
U001	31.3	1	B
U072	36.7	1	B
U079	40.3	1	B
U093	42.9	1	B
U075	55.7	1	C

NOTE FOR FIGURES

1. OC Parameter No. : see Table 4.1.2a
2. CH Parameter No. : see Table 4.1.10a
3. PAH Parameter No.: see Table 4.1.14

Fig. 4.1.1a Percent Recovery for OCs

(Identical Samples)

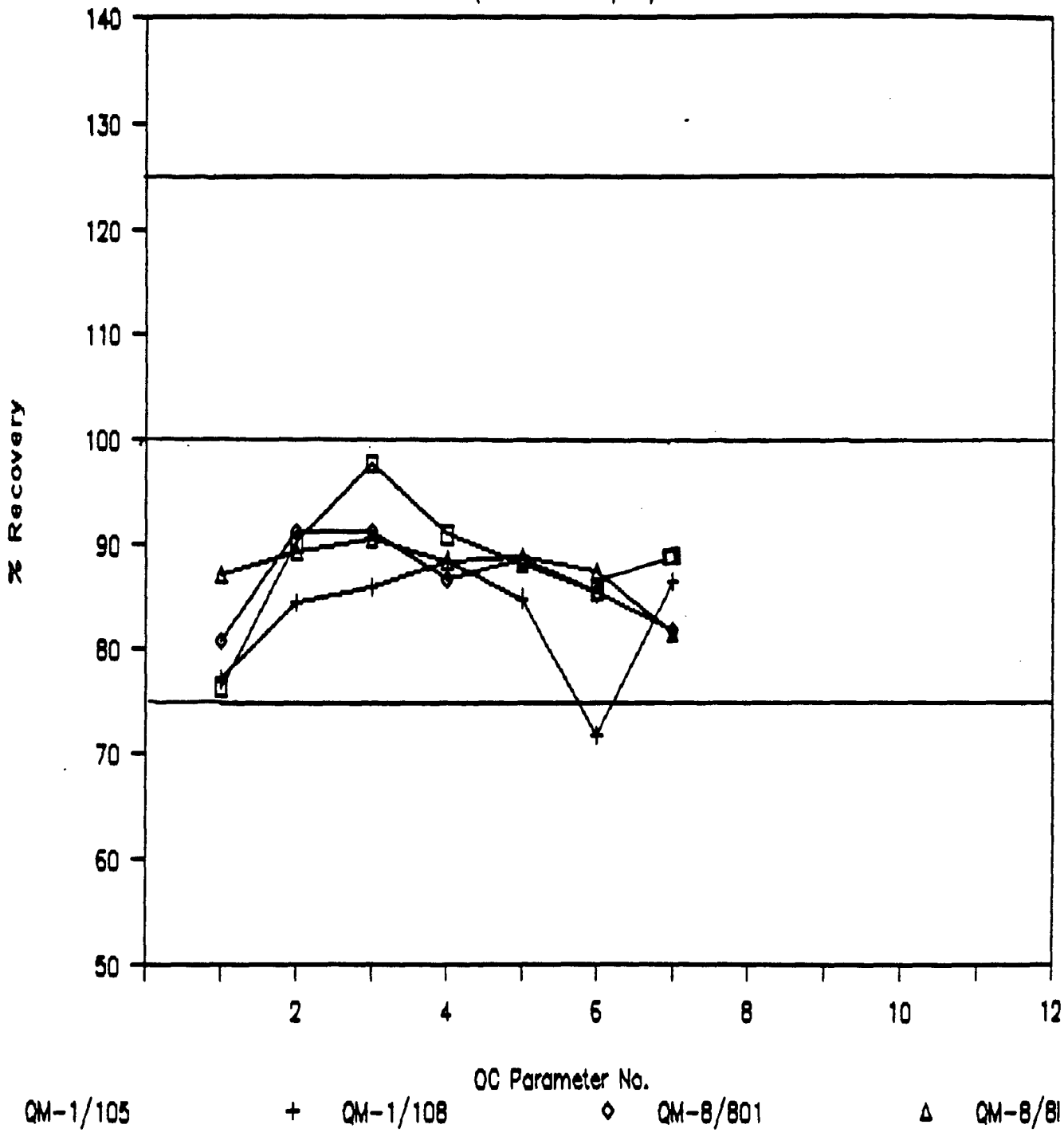

Fig. 4.1.1b Percent Recovery for OCs

(Identical Samples)

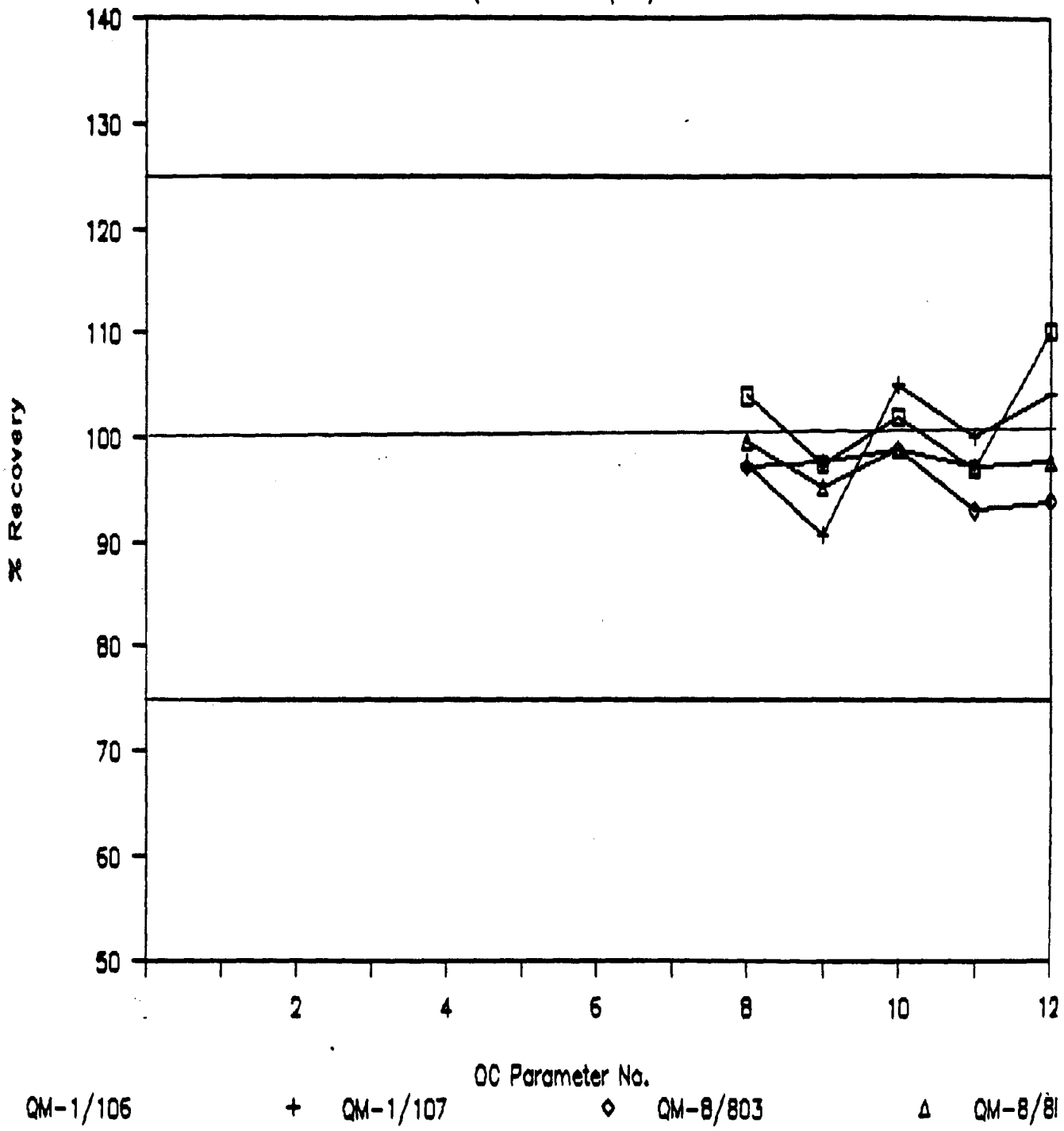

Fig. 4.1.2 Avg. Recovery (%) for OCs

(Various Studies)

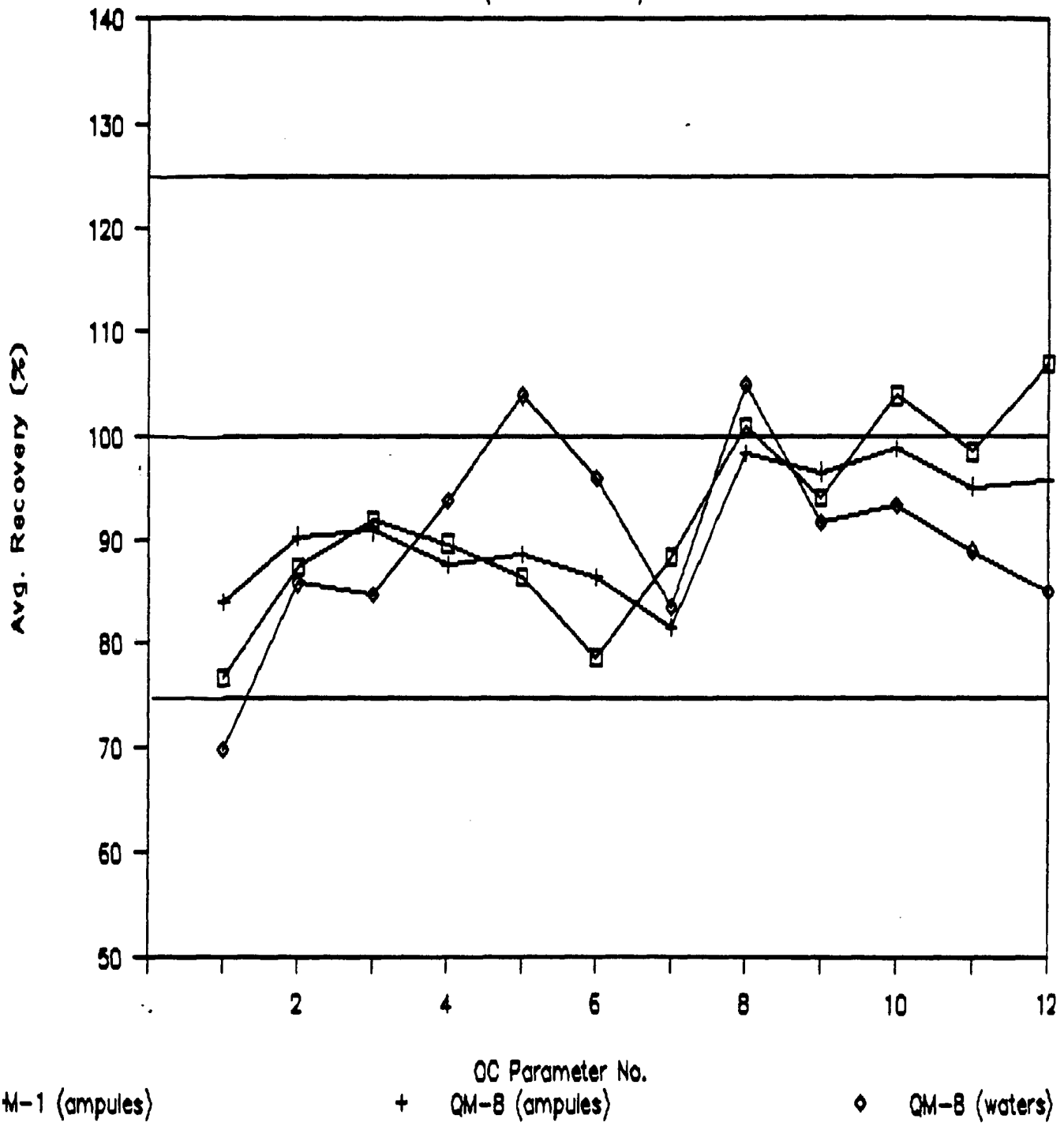

Fig. 4.1.3 Avg. RSD (%) for OCs

(Various Studies)

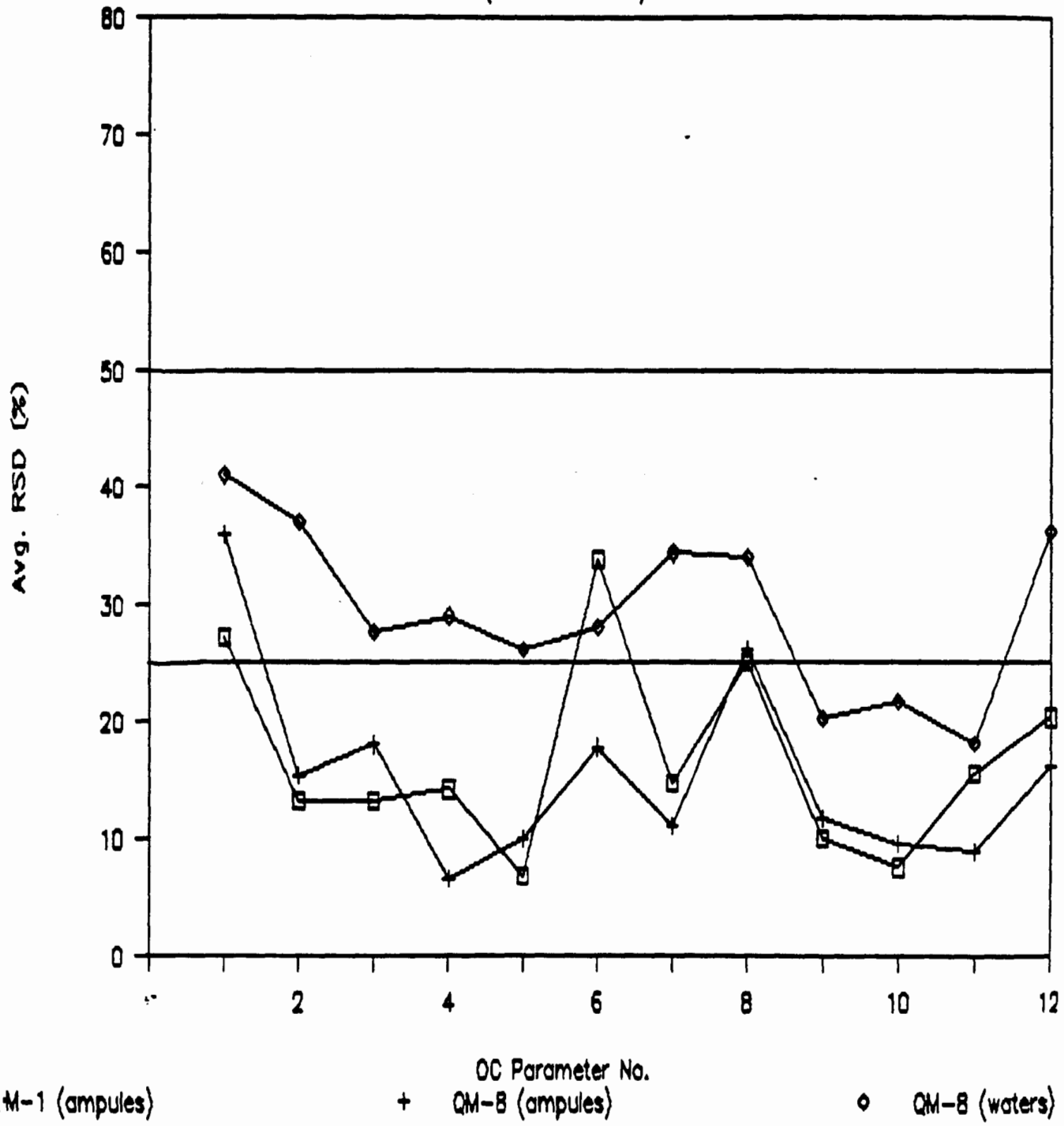

Fig. 4.1.4 Percent Recovery for PCBs

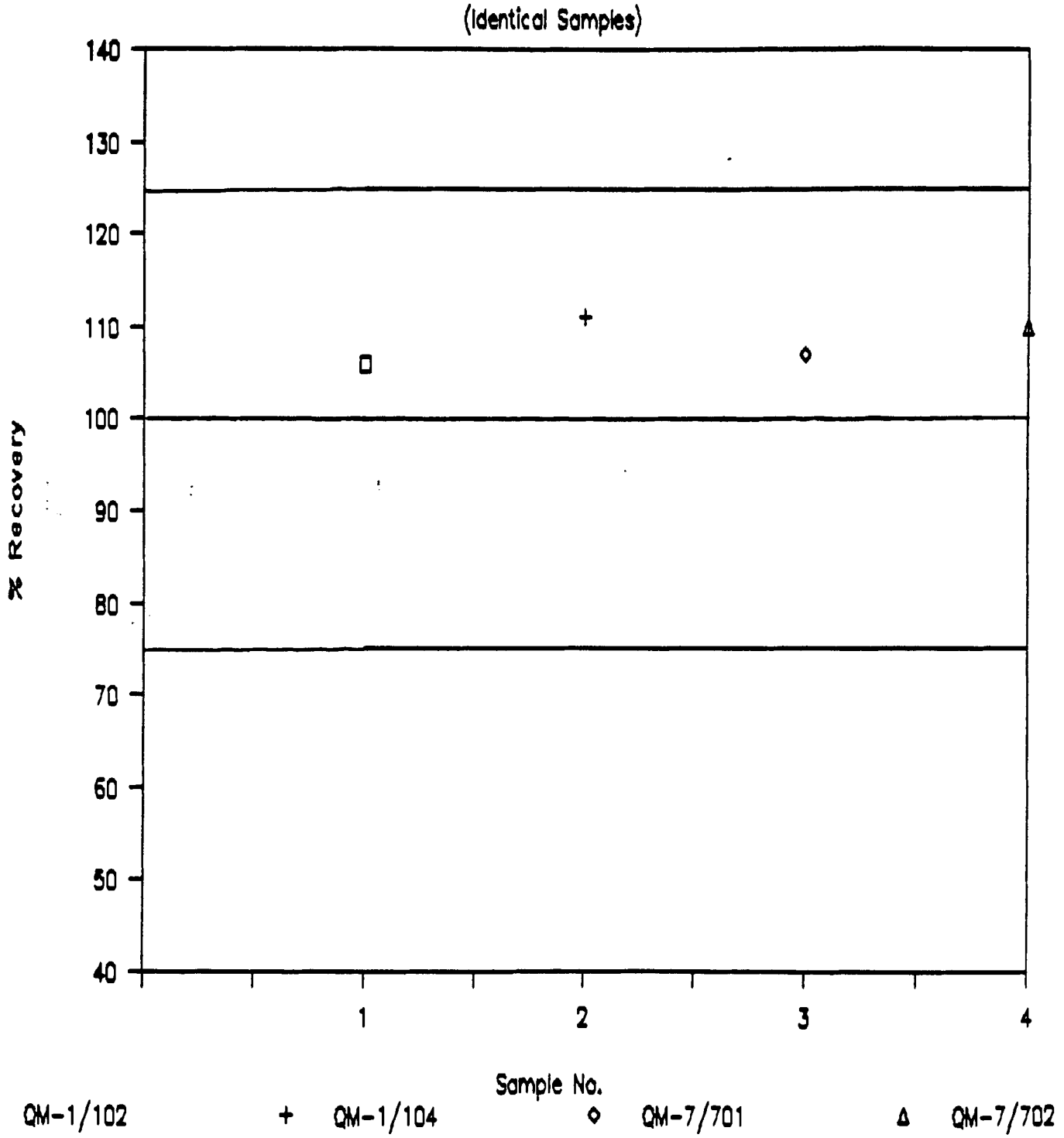

Fig. 4.1.5 Percent Recovery for PCBs

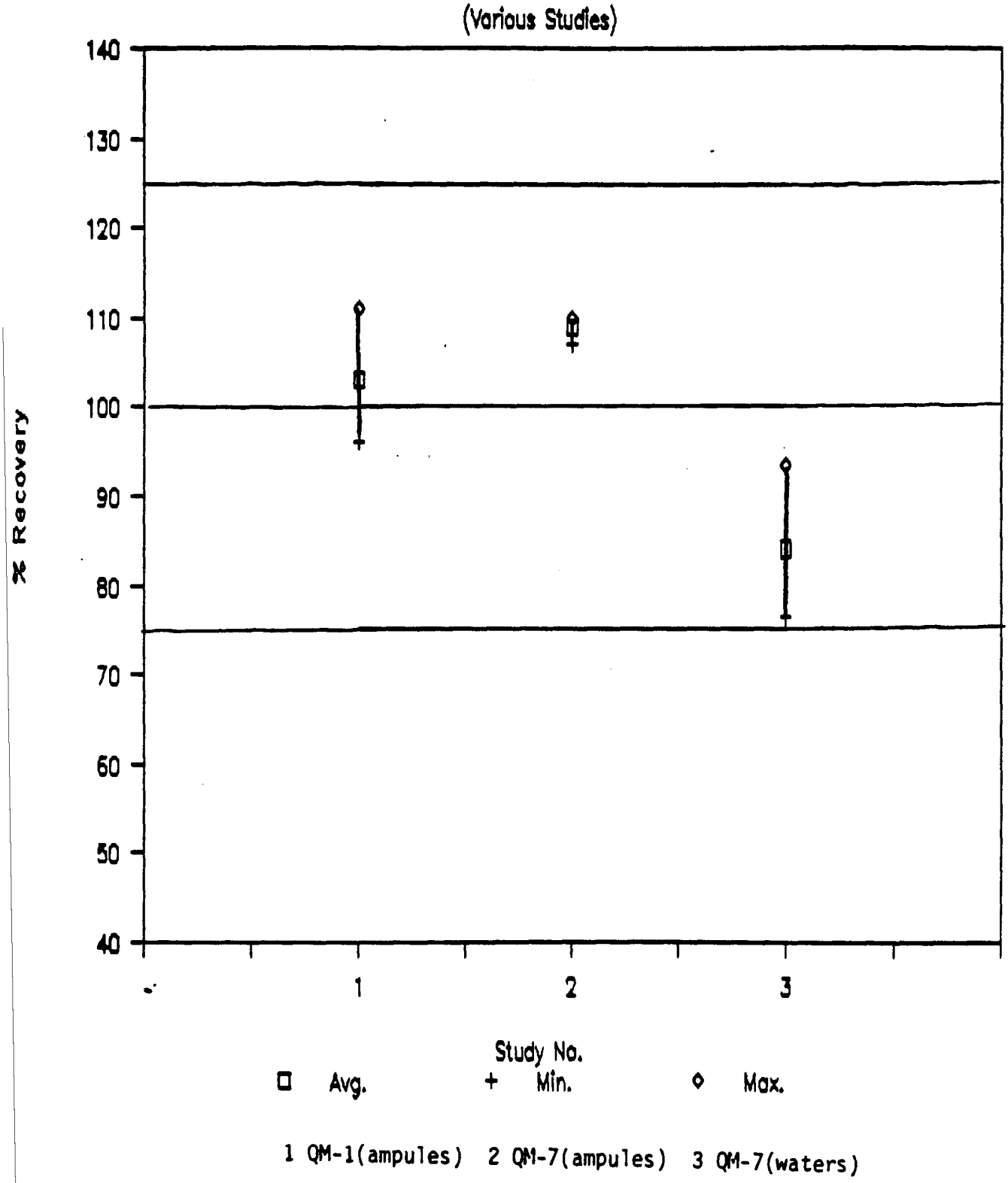

Fig. 4.1.6 RSD for PCBs

(Various Studies)

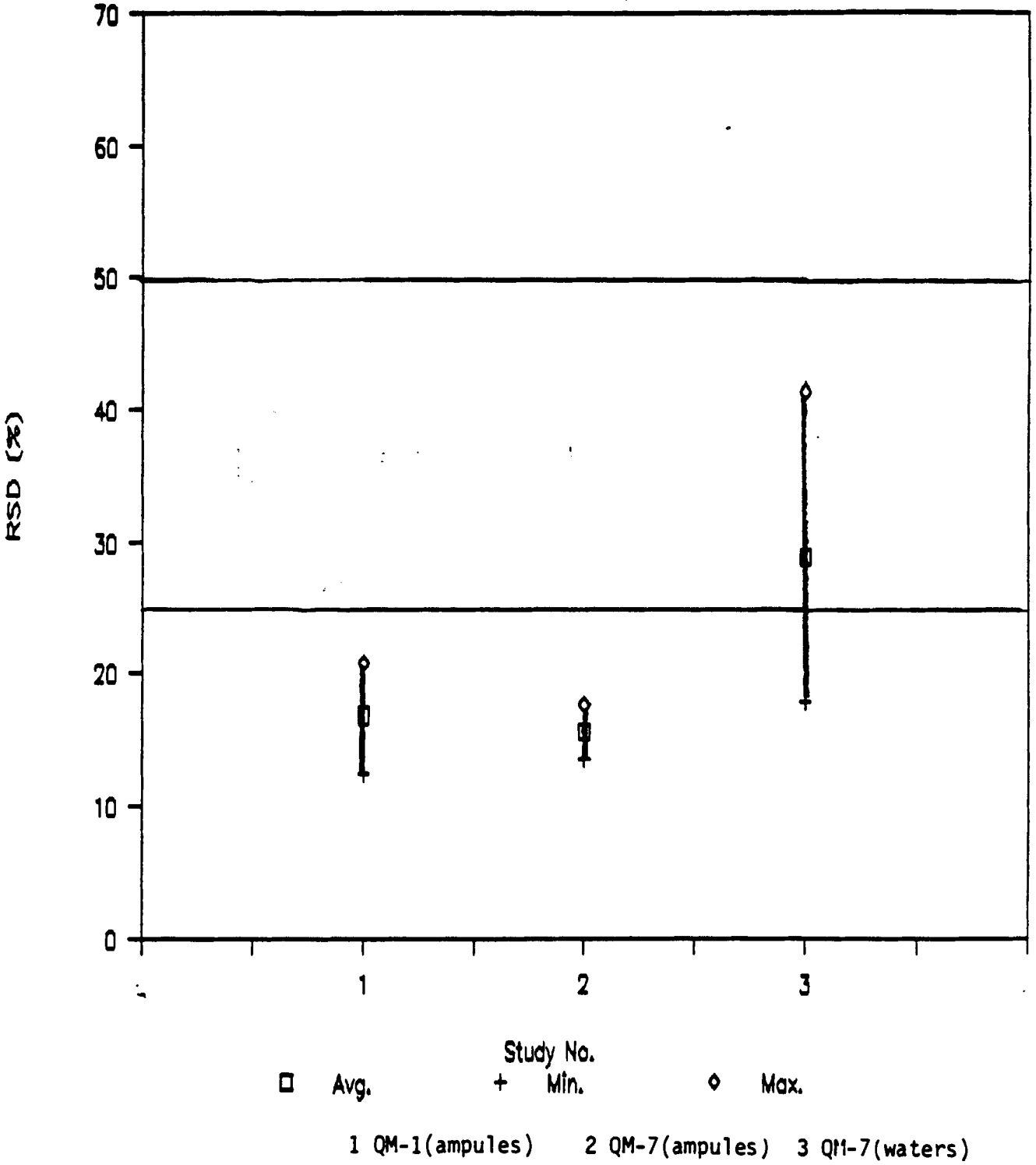

Fig. 4.1.7a Percent Recovery for CHs

(Identical Samples)

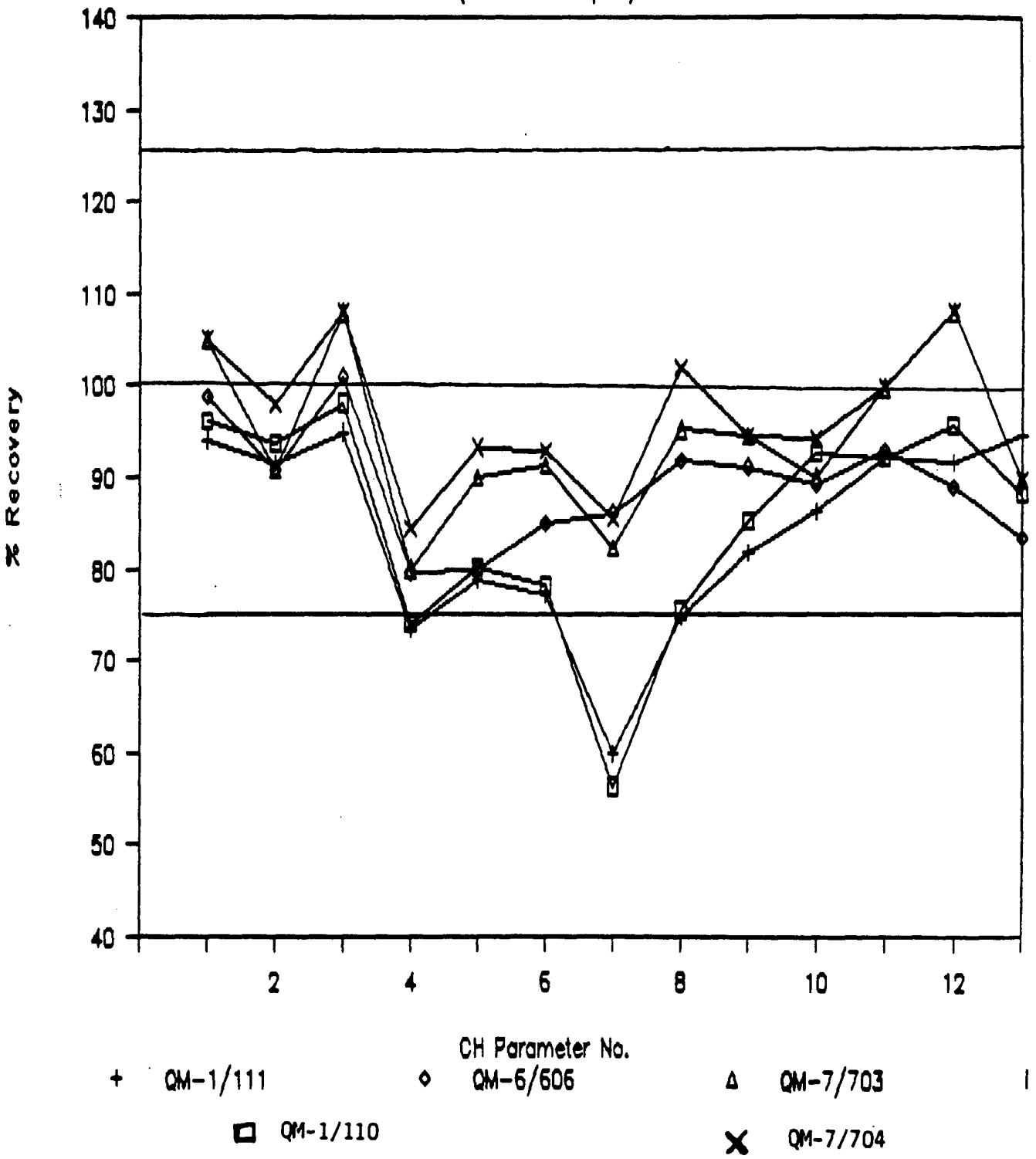

Fig. 4.1.7b Percent Recovery for CHs

(Identical Samples)

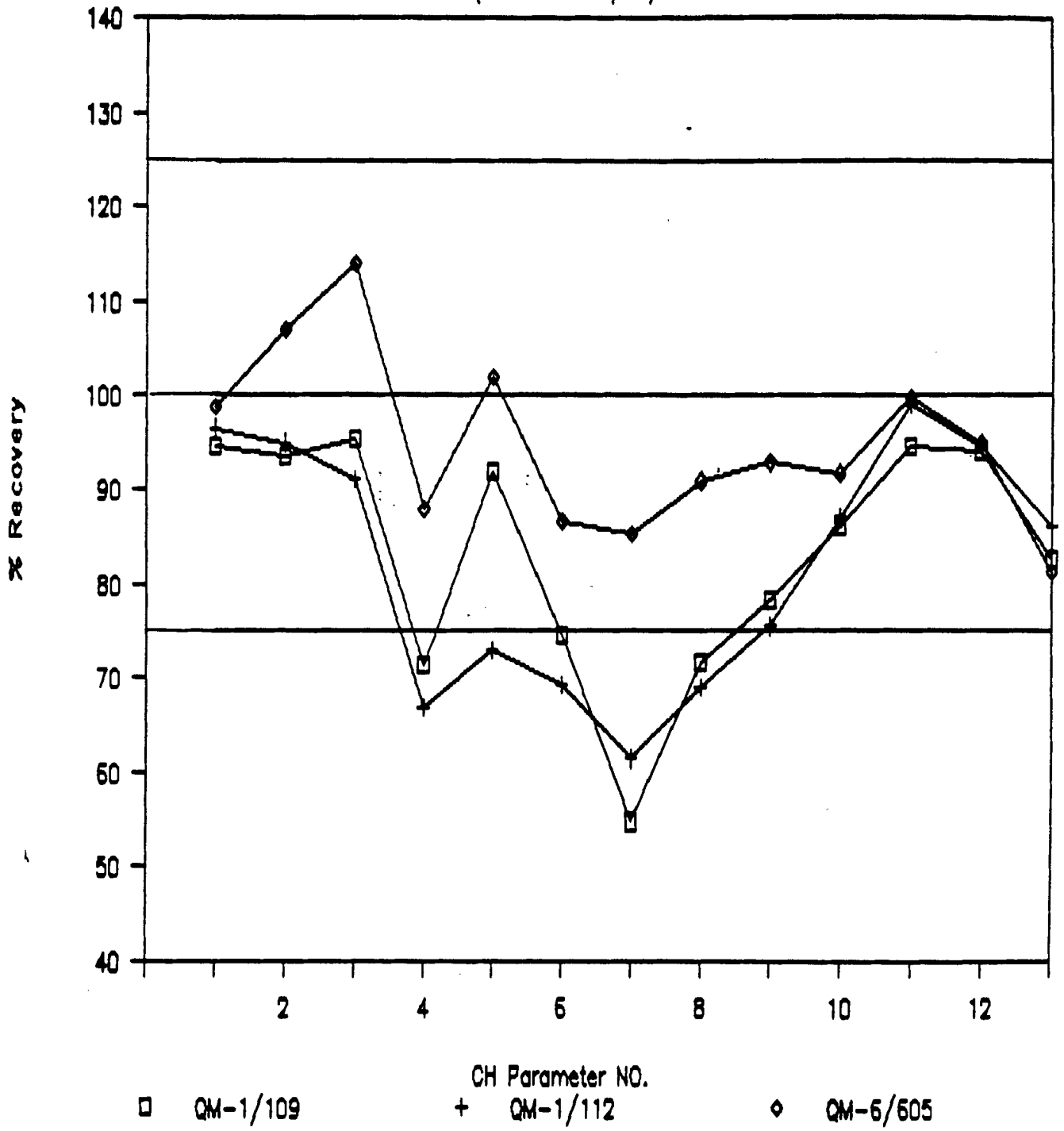

Fig. 4.1.8 Avg. Recovery (%) for CHs

(Various Studies)

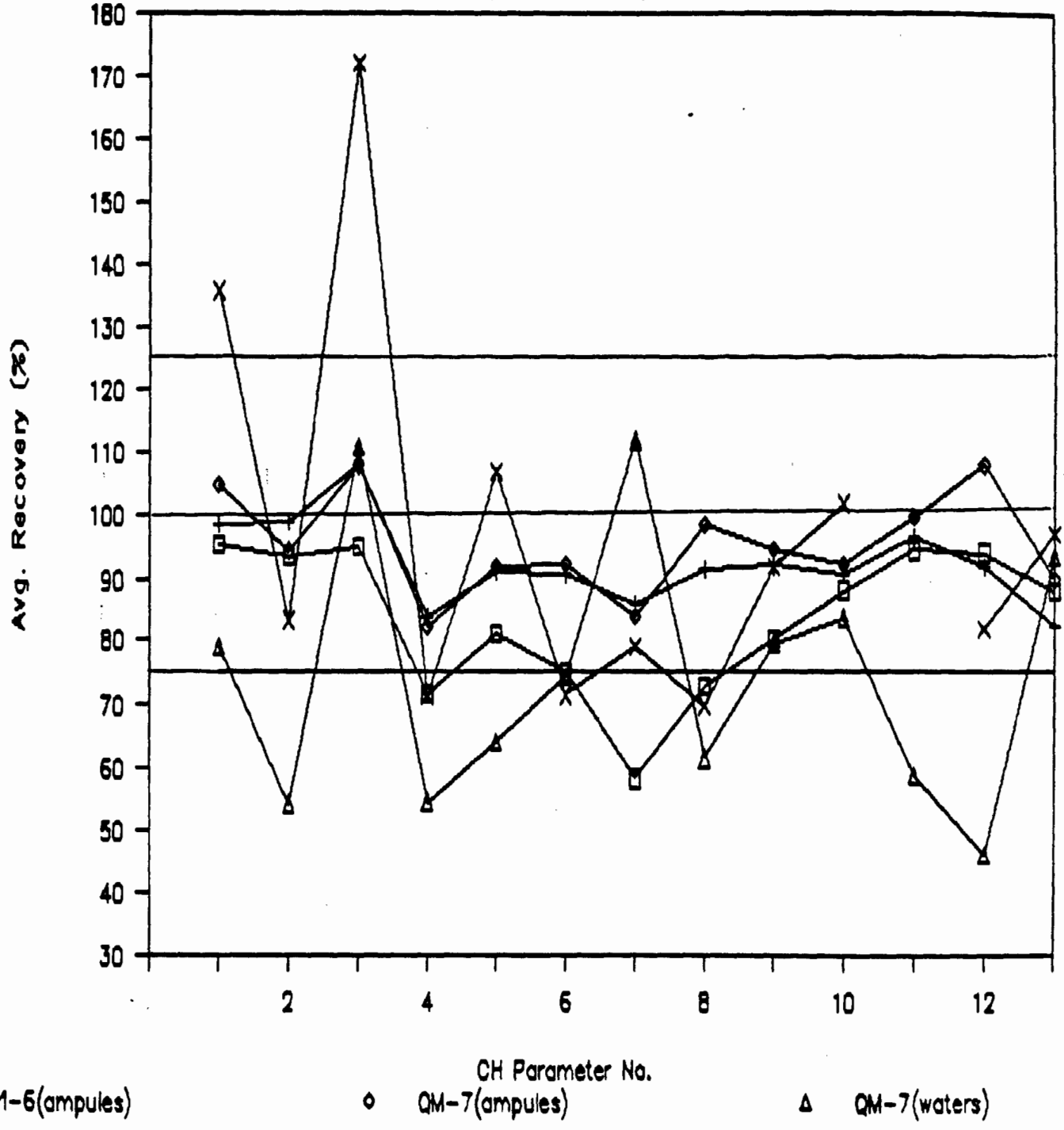

Fig. 4.1.9 Avg. RSD (%) for CHs

(Various Studies)

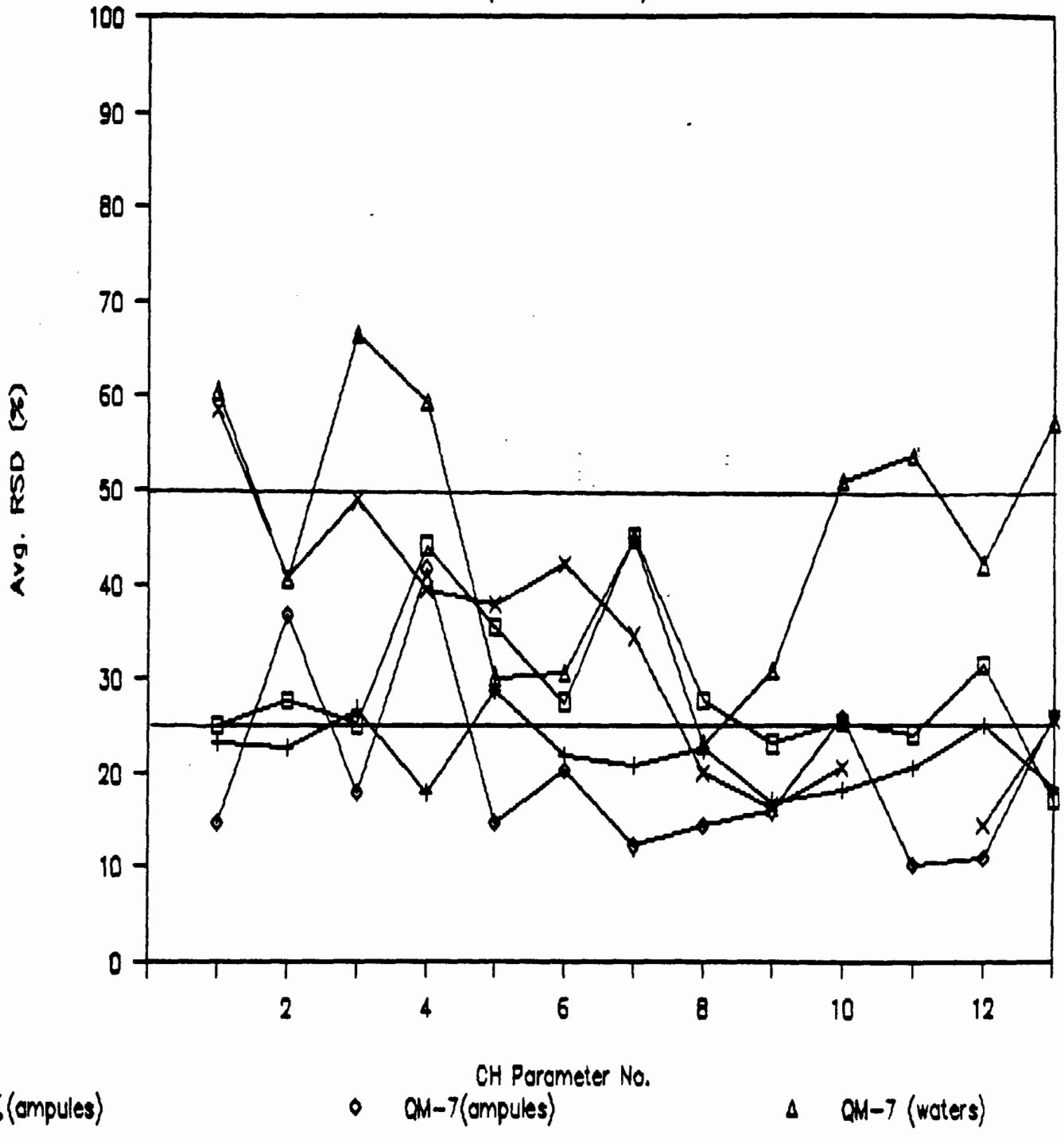

Fig. 4.1.10 Percent Recovery for PAHs

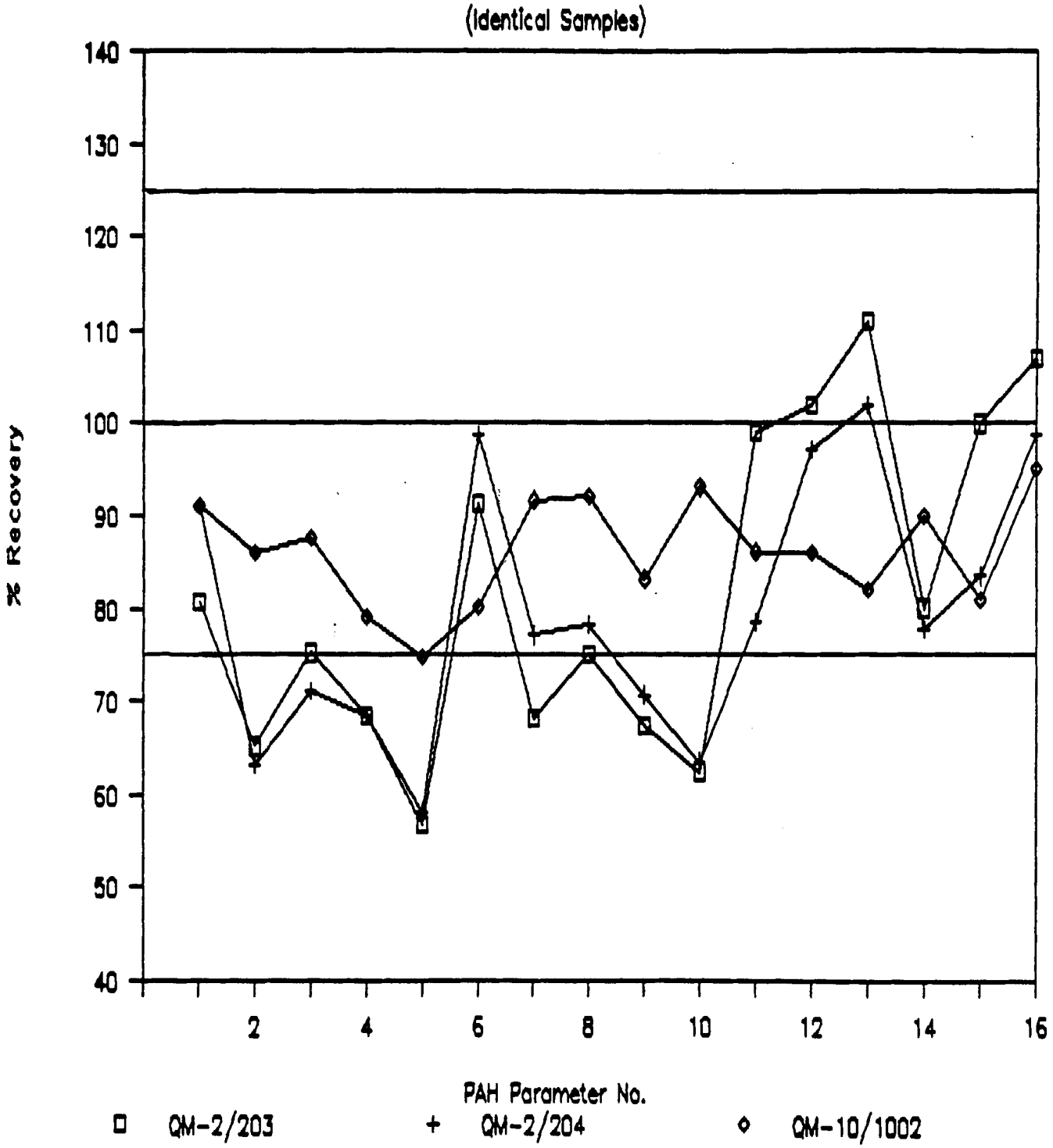

Fig. 4.1.11 Avg. Recovery (%) for PAHs

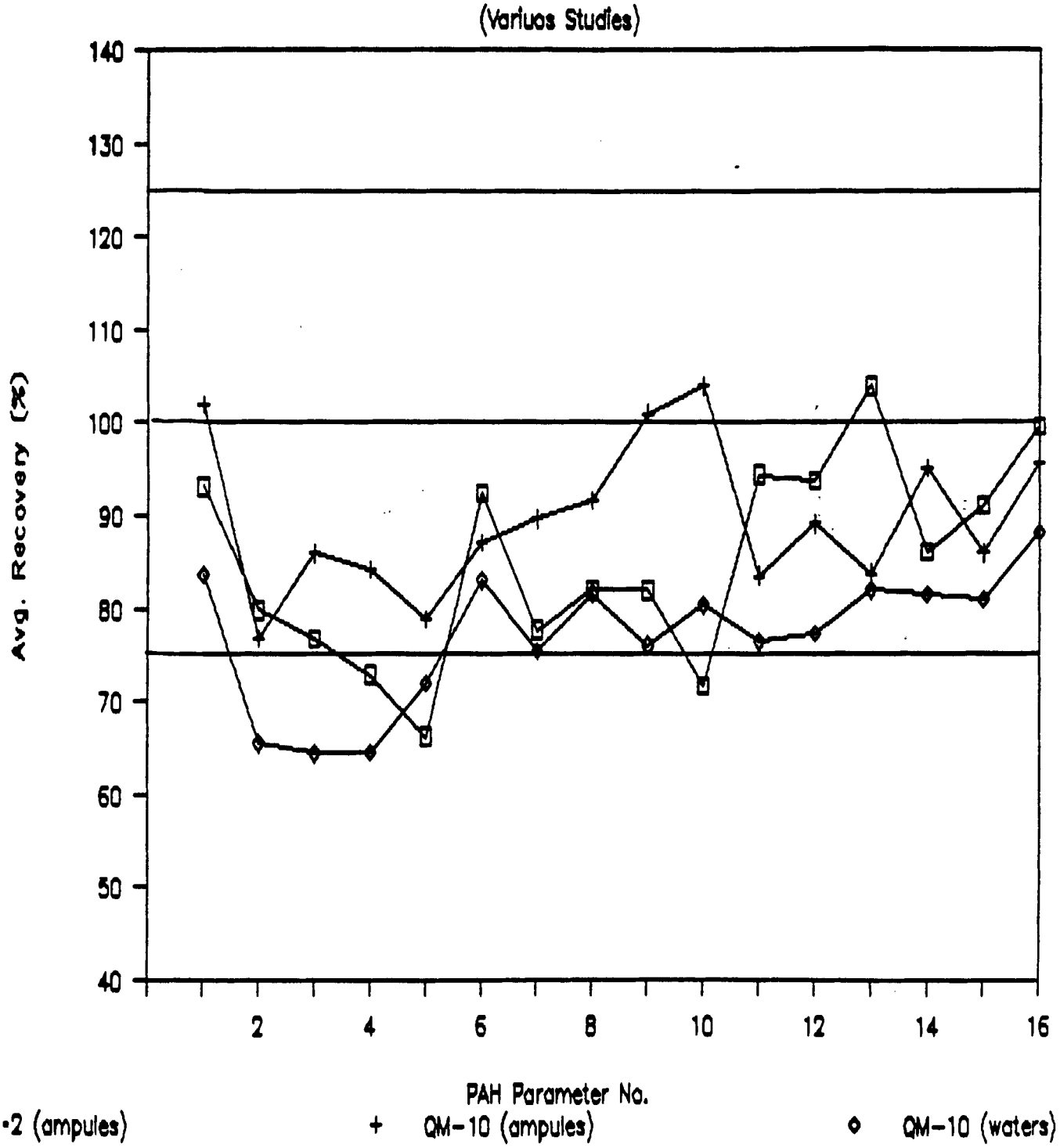

Fig. 4.1.12 Avg. RSD (%) for PAHs